W Jencks

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RENEWAL OF NIAGARA SUSPENSION BRIDGE.

The re-enforcement of the anchorage and the renewal of the suspended superstructure of the Niagara Suspension Bridge, without a moment's interruption of traffic, rank as one of the most prominent feats of modern engineering; and the fact that, with a slight exception, the wires forming the cables and suspenders were found by the inspecting engineers unimpaired, is most significant and reassuring.

We have taken extracts from the report of Mr. Leffert L. Buck, engineer of the work, and give engravings from the engineer's drawings and from photographs furnished by Mr. William G. Swan, superintendent of the bridge.

From the inception of the project of spanning the chasm of the Niagara River below the falls with a suspension bridge for railroad purposes, to the year 1855, when the bridge was completed and opened to traffic, it was considered a bold undertaking, and by some engineers, even, as an impracticable one. But the bridge has been in constant use for twenty-five years, and under constantly increasing traffic, demonstrating the adaptability of a wire suspension bridge to a locality requiring extremely long spans.

In spite of its success, however, it has been an object of constant solicitude to the traveling public. The frightful chasm that it spans would naturally excite the fears of most people, and this feeling has been greatly enhanced by doubts as to the condition of the cables and their anchorage.

The bridge consisted of two pairs of iron wire cables and the suspended superstructure, the cables resting on masonry towers at each end of the bridge, their ends being secured by means of chains to suitable cast-iron anchor plates bedded in the rock forming the banks of the river.

The suspended superstructure consisted of two floors, placed at a vertical distance apart of 17 feet, and connected by posts and rods in such a manner as to form a trussed tube, as shown in Fig. 2. At each five feet in the length of the trusses, two wire rope suspenders connect the upper floor with the upper cables. In the same manner the lower floor is suspended to the lower cables.

Each cable is composed of seven strands or bundles of wire. Each strand is made up of 520 scant No. 9 wires laid parallel, and at each end formed into a loop which fits into a groove in a U-shaped cast iron shoe. The seven strands are bound into one bundle of 3,640 wires, which is served closely with wire over the whole length, with the exception of about 13 feet at each end, and of about 10 feet of the portions resting on the towers, thus forming a cylindrical cable $10\frac{1}{8}$ inches in diameter.

The tops of the towers are each covered with a cast iron plate, 8 feet square, bedded in mortar. The upper surface of this plate is planed to a true surface and supports a number of turned rollers 5 inches in diameter. On these rollers rest the saddles, consisting of heavy castings whose undersides are planed. The top of each saddle has a groove of semicircular section in which the wires of the cable lie, each cable having a separate saddle. The planes of the curves of the cables, between the towers, are inclined in such a manner as to bring those of each pair nearer together at the middle of the span, to give lateral stability to the bridge. From the towers to the anchorage the cables diverge from the center line of the bridge sufficiently to make the plane containing the portion each side of the tower vertical. The wire forming the cables was boiled in linseed oil before it was laid, and as the cables were made the interstices at the shoes and towers were flushed with boiled linseed oil and Spanish brown paint. Then the whole length of the cable was flushed with the same as the serving progressed.

Each end of each cable had a separate anchorage, as shown in dotted lines in Fig. 3.

A rectangular pit or shaft, 3 ft. x 7 ft. in plan, was sunk vertically into the rock, to a depth of 25 feet, with the bottom enlarged to form a chamber 7 feet square. An anchor plate, 6 feet 6 inches square and having seven rectangular openings through it to receive the lower links of the anchor chain, is set in the chamber, the links put in position, and secured by a $3\frac{1}{2}$ inch diameter pin passed through their heads and underneath the plate. From the plate the chain passes vertically upward to the surface of the rock. From this point the joints of the chain are at points of a vertical curve of 25 feet radius, the joint at the upper end of the curve forming the point of the tangency with the line of the cable.

Beyond this joint is another length of chain composed of nine links, eachbar of which is 10 feet long and 7 x $1\frac{3}{8}$ inches section. Four of these links alternate with the shoes of three of the strands of the cable, and are secured to them by a $3\frac{1}{2}$ inch diameter pin passing through links and shoes. The remaining five links are in like manner connected with the remaining four shoes of the cable strands.

The anchor plates are secured in the chambers by means of neatly fitted stone blocks set in cement mortar, the whole pit being solidly filled with cement masonry, and the interstices around the bars grouted. Above the rock and up to the end of the chain the whole is inclosed in a solid wall of masonry, heavy blocks of which form supports of the joints of the curved portion of the chain. Formerly the strands were also covered with masonry and the whole grouted, the intention being to preserve them from corrosion.

Such, in brief, is the description of the cables and anchorages before the new work was begun.

The appearance of the old superstructure of wood, and wire suspenders and stay cables, is familiar to all who have seen the bridge, or pictures of it, and therefore need not be fully described in this connection.

In February, 1877, Mr. Thomas C. Clarke, Member Am. Soc. Civil Engineers, with a view to examining the condition of the portions of the cable strands embedded

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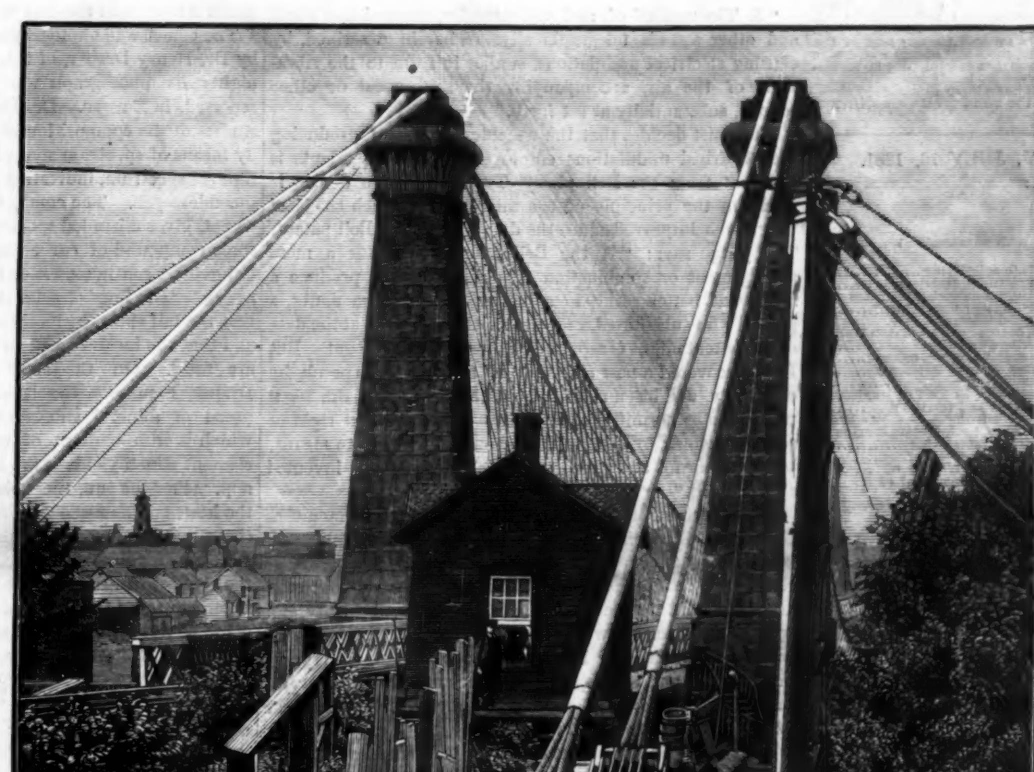

RENEWAL OF NIAGARA SUSPENSION BRIDGE—RE-ENFORCEMENT OF THE ANCHORAGE.

Scientific American.

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NEW YORK, SATURDAY, JULY 16, 1881.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 289,

For the Week ending July 16, 1881.

Price 10 cents. For sale by all newsdealers.

IMPORTANT TELEPHONE DECISION.

Judge Lowell, of the United States Circuit Court, Boston, Mass., rendered an important decision on the 27th ult., in which he virtually confirms to the American Bell Telephone Company, *the exclusive right of talking over a wire by electricity*. If this decision is correct, then the Telephone Company is in possession of one of the most gigantic and extraordinary monopolies ever obtained by an individual or acquired by a private corporation. It will almost bear comparison with the patent issued by the Spanish sovereigns to Christopher Columbus for his discovery of the New World, by which the continent, its peoples, and their possessions, were placed under his thumb and that of his heirs forever. But the magnitude of that grant caused its ultimate downfall; and possibly the Bellonian patent may, with more justice, meet a similar fate when it reaches the Supreme Court of the United States.

If it does not, if this decision stands, what a marvelous honor belongs to Alexander Graham Bell! What an astonishing benefit he has conferred upon his fellow men! He is declared to be the original and first discoverer of the far-reaching art of speech transmission by electricity.

The suit in question was brought by the American Bell Telephone Company against Albert Spencer and others, and the decision, as we understand, is based on the fifth clause of Bell's claim, patent of February 14, 1876, as follows:

"5. The method of, and apparatus for, transmitting vocal and other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air, accompanying the said vocal or other sounds, substantially as set forth."

The court decides that the specific method of producing the electrical undulations employed by the defendants is different from the Bell plan. The defendant's device is made on the principle of the microphone, which has been very much improved since the date of the first Bell patent. The judge says: "If the Bell patents were for a mere arrangement or combination of old devices to produce a somewhat better result in a known art, then, no doubt, a person who substituted a new element not known at the date of the patent might escape the charge of infringement. But Bell discovered a new art—that of transmitting speech by electricity, and has a right to hold the broadest claim for it which can be permitted in any case—not to abstract right of sending sounds by telegraph without any regard to means, but to all means and processes which he has both invented and claimed."

It has been heretofore supposed by electrical laymen that Bell's devices are simply improvements upon something previously done in the same line by others, such as Œrsted, Reiss, Gray; and that consequently Bell's broad claim to the art of transmitting speech by electricity was an absurdity, and would be so declared whenever it was submitted to a proper judicial examination. But a trial has been had, the laymen are defeated, and the hopes of hundreds of telephonic inventors laid low in the dust. It may be, however, that the near future has relief for them in store.

Judge Lowell pays a just tribute to the learning and ingenuity of Professor Reiss, but holds that his telephone of 1860 was an imperfect instrument, which, although some sounds of the voice could be sent, was still incapable of completely transmitting articulate speech. This differs from accounts we have had of the Reiss telephone, and perhaps the entire evidence in respect thereto was not brought out before the court.

It may equally be said of Bell's telephone, that while it is a good receiver it is a poor transmitter—so poor that its use has been almost abandoned in favor of superior instruments such as the Blake or the Edison. If we had to rely only on the Bell instruments the telephone would be a nuisance, and the wide-spread use of speaking telegraphy now enjoyed could never have been realized.

THE GREAT COMET OF 1881.

The comet whose appearance was announced last week continues to be the subject of much wonder, speculation, and scientific study. Though less striking in appearance than Donati's comet of 1858, it is one of the most brilliant and interesting of these erratic visitors to our skies that scientists have been permitted to study.

So far as heard from the comet was first observed in the northern hemisphere about four o'clock of the morning of June 20, by G. W. Simmons, Jr., of Boston, while camped at Moreles, Mexico, 30 miles west of Eagle Pass, west of the Rio Grande, about latitude 29.

It appeared in constellation Auriga, about 8 degrees from the star Capella, and from its proximity to the sun was at first visible each clear day only for a short time just before sunrise and again for a little while in the evening. Its northward motion, however, soon carried it to a position permanently above the horizon. At first the head of the comet shone like a star of the first magnitude, while the tail glowed like a streamer of the northern lights.

In the absence of a sufficient number of observations for the exact calculation of the elements of the comet's orbit the estimates of the dimensions of the head and tail and their distance from the earth are little better than guesses. At Harvard University, on the 24th, the comet was thought to be about 69,000,000 miles from the sun and 29,000,000 miles from the earth. The nucleus was estimated to be 1,000 miles in diameter, the coma or nebulous head 12,000 miles in diameter, and the tail 40,000,000 miles long.

On the 27th Prof. Lewis Boss, of Dudley Observatory, Albany, N. Y., calculated the comet to be about 34,000,000 miles from the earth, and receding at a rate of nearly 1,000,000 a day. At that date the nucleus was estimated by him to be 1,200 miles in diameter, and the first and brightest semicircular envelope of the head appeared about 14,000 miles broad. The largest branch of the tail measured, he thought, at least 35,000,000 of miles.

On the night of the 26th, as seen from the same observatory, the tail was traced for forty degrees. One branch of the tail passed in a perfectly straight line about two degrees to the East of the Pole Star. The other branch was shorter and fainter, and curved to the westward (eastward, astronomically), terminating at a point about five or six degrees southwest of Polaris. The air was wonderfully transparent, and the fine gauze-like tail became an object of delicate and fascinating beauty.

Thus far no agreement has been arrived at among astronomers touching the comet's identity and orbit. By some its (approximate) elements are thought to resemble most those of the comet of 1807; others find greater resemblance to the elements of the comet of 1684. The majority of observers hold that the comet is receding, having made its perihelion passage some time in June, various dates being given. Most probably the comet is the one observed by Dr. Gould in South America on the first of June.

The comet was photographed for the first time June 26, by Dr. Henry Draper, of this city, and on several succeeding nights its photograph was secured here, and also, it is reported, in Europe. Dr. Draper has likewise made careful studies of the composition of the several parts of the comet by means of spectrum analysis. The nucleus gives a continuous spectrum, indicating a solid or liquid body heated to incandescence. The coma, or cloud about the head of the comet, gives a banded spectrum indicating the presence of some compound of carbon in the gaseous envelope. The tail gives a continuous spectrum which is not crossed by the characteristic lines of solar light, from which it is inferred that the tail shines by its own light, not by reflected sunlight, and that the incandescent particles which compose the tail are solid. On the strength of these discoveries Dr. Draper expresses the belief that the nucleus is composed of mineral substances, partly, perhaps, of olivine, which is an ingredient of meteorites, and of some volatile element which yields to the influence of heat. As the comet approaches the sun, the volatile part is turned into gas by the heat, and flames out to form the coma. The fact that the coma is always on the sunward side of the nucleus strengthens this supposition. But after bursting forth on the side toward the sun, the vapor seems to be repelled and to stream away from the sun, thus forming the tail. The cause of this repulsion cannot be absolutely asserted; but in all probability electricity has something to do with it.

CHEMICAL ACTION IN A MAGNETIC FIELD.

Every student is familiar with the experiment in which fine iron filings are dusted over a plate and subjected to the influence of the poles of a magnet. The iron does not remain uniformly distributed, but falls into systems of lines which mark what are called the lines of magnetic force. Excellent illustrations of these curves will be found in connection with Professor Mayer's articles on magnetism (SCIENTIFIC AMERICAN, vol. xli., pages 211, 212, etc.). These lines of magnetic force occupy what Faraday named the magnetic field which surrounds the poles of every magnet to a distance greater or less according to the strength of the magnet. Recently Professor Ira Remsen, of Johns Hopkins University, has undertaken some novel experiments to ascertain whether the chemical behavior of a metal is in any way influenced by magnetic action, and has arrived at results which are of considerable interest.

His best effects were obtained by placing a shallow vessel of thin iron, containing a solution of copper sulphate, over the poles of a magnet. Out of the magnetic field the solution would deposit upon the iron vessel a uniform coating of copper. When brought within the field of a permanent magnet capable of supporting twenty-five kilogrammes (55 pounds) the copper was deposited in a fairly uniform way on the entire plate except at the lines marking the outlines of the poles. These lines were sharply marked as depressions in the deposit. When, instead of a permanent magnet, an electro-magnet was employed, the iron vessel and copper solution being the same as before, a more striking action was observed. There was no deposit of copper for a narrow space marking the outline of the poles. Within the outline (over the poles) the deposit was fairly uniform. Outside the blank outline marking the pole the copper was deposited in irregular ridges running at right angles to the lines of force and apparently coincident with the lines marking the equipotential surfaces. By increasing the power of the electro-magnet the action is intensified and the area affected is broadened, the largest circles obtained in Prof. Remsen's experiment being nearly four inches in diameter. The cause of the phenomenon has not yet been determined, though the effects are obviously to be ascribed to the influence of the magnetism on the iron plate, or on the liquid, or on both together. Further experiments will decide between these possibilities. A full report of the work thus far done will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT. The experiments are easily repeated, and open up a novel and interesting field of inquiry.

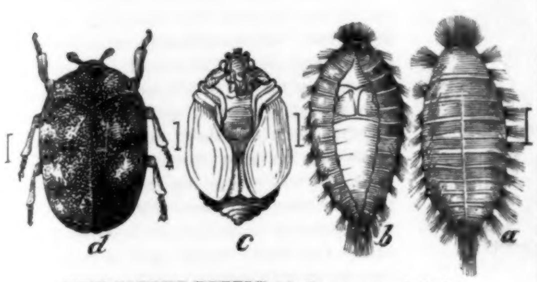
THE SPREAD OF THE CARPET BEETLE.

In the latter part of May, Master Fred. F. Richardson, of Tarrytown, N. Y., called our attention to the fact that the new household pest, the carpet beetle (*Anthrenus scrophulariæ*), had appeared on the blossoms of the field daisy. Further observation discovered the insects in considerable numbers on the flowers of the *Deutzia*.

A statement of the facts (with specimens of the beetles) was sent to Professor Comstock, U. S. Entomologist, at Washington, in a letter asking whether the beetles had before been discovered leading an outdoor life.

Professor Comstock's answer, dated June 7, ran as follows:

In reply to your letter of recent date I would state that the beetles sent were specimens of the imported carpet beetle (*Anthrenus scrophulariæ*), as you surmised. Since the beetles



NEW CARPET BEETLE (*Anthrenus scrophulariæ*).

of this group are known to generally feed upon the pollen of flowers in the adult stage, while their larvæ are miscellaneous feeders, there is nothing surprising in your observation; still it is of interest, as I am not aware that it has been recorded as yet in this country, except with regard to the California variety of the species, which Dr. Le Conte has called *A. lepidus*. Professor Lintner said, in 1878, "The insect has not yet become sufficiently abundant in New York to be found resorting to plants for its food," and I do not recall at the present moment that I have seen this statement corrected since.

Very respectfully yours,
J. HENRY COMSTOCK, Entomologist.

The inference to be drawn from this discovery is not encouraging to housekeepers. The beetles, in the larval condition, have already proved very destructive to carpets, and scarcely less so to woolen goods generally, wherever they have gained a footing; and now that they are multiplying out of doors there is little hope of their extermination.

It will be remembered that this latest and least welcome of immigrants from Europe was first discovered preying upon carpets by Professor J. A. Lintner, Entomologist of New York State, in 1874. In its native home it is said to have shown no such proclivity, whether from lack of carpets or an abundance of more attractive food it is impossible to say.

In the thirteenth annual report on the New York State Museum Professor Lintner gave a full description of the insect, with figures by Professor C. V. Riley. We copy the figures herewith for the information of housekeepers, who may not be aware that the pretty little beetles found crawling about the walls have anything to do with the hairy destroyers of their carpets, blankets, and woolen clothing. The tail-like tuft of black hair radiating from the last segment of the larva has been clipped in the picture; naturally it is nearly as long as the whole body. The indicated size of the beetle is for the female; the male is about half as large, and is whiter. A full description of the beetle in its several stages was given in the SCIENTIFIC AMERICAN of October 5, 1878. At this time the pest is only too well known, and the chief question with regard to it is how to stay its ravages.

There is a remote possibility that the attractions of outdoor life may withdraw the pest from the domestic field and cure it of its newly acquired taste for carpets. But it is far more probable that, after multiplying outside during the summer months, it may swarm into our houses in the fall with vastly increased numbers and capacity for mischief. Meantime householders will do well to watch closely to see whether the female beetles do not leave the flowers and betake themselves to the house to deposit their eggs upon carpets and clothing. In this case the ravages of the larvæ may be kept up the year round, and not, as heretofore supposed, during a few months of winter or early spring only.

The remedies proposed for the pest are numerous, but most of them are disappointing when put to practical test. In the report referred to above Professor Lintner says that Persian insect powder, camphor, pepper, tobacco, turpentine, carbolic acid, and the like are powerless. He recommends the use of benzine or kerosene on cotton stuffed into the joinings of the floors and the crevices beneath the baseboards. An efficient but somewhat hazardous remedy is said by others to be found in the liberal use of naphtha around the sides of the room, along the seams of the carpet, and wherever cracks in the floor provide a runway for the larvæ under the carpet. Obviously great care must be taken to give the rooms a protracted and thorough airing before lighting lamps or fires, as the naphtha takes fire readily and the vapor mixed with air is dangerously explosive.

In view of the fact that the larvæ of a related species of beetle abhors tallow it has been suggested that a remedy for the carpet beetle might be found in the liberal use of tallow in the cracks of the floor and around the edges of the wall where an invasion is feared. In Europe, however, the insect is said to infest dried meat, in which it is liable to come in contact with fat; and it is such an omnivorous creature in the larval state that it might possibly betake itself to tallow as a relish. Its taste for carpet-stuff, as already noted, is of recent origin, and there's no telling but it might learn to like even Professor Lintner's cotton soaked in kerosene.

A Massachusetts naturalist proposes the soaking of the edges and seams of carpets with an infusion of cayenne pepper and strychnia—one-quarter pound of pepper and two drachms of strychnia powder to the gallon of water. We do not know of any actual test of this remedy, which is objectionable because of its hurtfulness to man. Another (theoretical) remedy is an infusion of cayenne pepper and quassia chips—two ounces of pepper and half a pound of quassia to the gallon of water—which has the merit of not being poisonous. These infusions can be applied to new carpets by dipping the ends of the rolls in a shallow pan containing the liquid; to carpets already down the liquid might be applied with an atomizer until the edges and seams are saturated.

The interests involved in this insect invasion are coextensive with the carpet and woolen industries; and it is clear that the inventor who shall devise some sure and simple treatment of carpets and clothing to make such articles proof against the pest, will not only make himself a public benefactor, but reap a suitable reward in cash. Thus far the naphtha and benzine applications seem to promise the best results; but they are somewhat hazardous, to say nothing of the disagreeable odor they leave. A pleasanter, safer, and more permanent preventive is needed.

GAMGEE'S ZEROMOTOR.

The SCIENTIFIC AMERICAN of July 2, 1881, contains an article on Gamgee's zeromotor, signed Valentine G. Bell, M.I.C.E., etc.

This writer expresses the opinion that the zeromotor will be able "to go on continuously during a given duty;" but that "a colossal engine will be required to do a very small amount of work;" and he suggests the following method for making an estimate of the size of the engine required, viz.:

"In a condensing steam engine there is a difference of about 1,000° Fah. [units?] of heat between the steam issuing from the boiler and the water returning to it. On the other hand, in Professor Gamgee's engine, this difference will not exceed 60°. Without going into the question of the relative specific heats of water and ammonia, we may say roughly that, for the two engines to indicate the same power when working at the same number of revolutions, they must have cylinder capacities in inverse proportion to the above differences of heat respectively."

Let us apply this rule for making an estimate for a zeromotor, to be substitued for the steam engine of a certain vessel, having two cylinders, 33 inches by 2·75 feet, working with a steam pressure of 60 pounds per square inch. The two pistons sweep through a space of 64·914 cubic feet per revolution of engines. According to Mr. Bell's opinion the pistons of the zeromotor should sweep through a space of $\frac{64{\cdot}914 \times 1{,}000}{60} = 1{,}082$ cubic feet per revolution of engines; and sixteen rotary engines, having cylinders 50 inches diameter by 5 feet long on an 8 inch shaft would be required, which, making proper allowances for cylinder heads, stuffing boxes, and couplings, would occupy fully 150 feet in the length of the vessel.

Mr. Bell's estimate, however, is based on wrong premises. The size of an engine for a given power depends on the indicated mean pressure of the working fluid, which is not dependent on the difference in temperature of, or units of heat contained in, the working fluid at its initial and final pressures. The following example will make this clear: Let us take two condensing engines, one working *without expansion* with steam of 100 pounds pressure, the other working with the same initial steam pressure, but *expansively*, so that the mean pressure in the cylinder is 20 pounds. Assuming the back-pressure to be the same in both cases and so small that it may be neglected, then the initial and final temperatures will be the same in both cases, but, with the same piston speed, the expansive engine must be five times larger than the non-expansive engine.

Mr. Bell's estimate of the size of the ammonia boiler is also based on wrong data. The mean difference of temperatures of the water and hot gases in a steam boiler is much less than 2,000° Fah.; this difference exists probably between the temperatures of the furnace and of the water; but when the gases leave the boiler their temperature is generally not more than from 200° to 300° higher than that of the steam.

It is doubtful whether Mr. Gamgee will derive much comfort from Mr. Bell's indorsement of his invention. The public, however, cannot be warned too much against this delusion. The utter fallacy of the principle on which the zeromotor is based may be illustrated in the following manner:

The heat stored up in a body is capable of doing a certain amount of work in the same manner as a mass of water stored up in a reservoir. To make the power of the water *available* for work, it must fall down to and flow off at a lower level. In the same manner the heat must fall down to, and flow off at a lower temperature; this is effected by the condensing water, or other refrigerating medium, of a heat engine. But as the zeromotor is to work without a refrigerating medium which carries off the heat contained in the working fluid at a lower temperature, it resembles a water power machine where the water falls from a reservoir into a well without an outlet at a lower level. The well will fill up, and the machine will stop.

Mr. Gamgee tries to remedy this evil by his high-pressure boiler, which is intended to supply the motive power of an injector by means of which the ammonia vapor and liquid is to be forced back into the working boiler. The operation of this high-pressure boiler may be likened to that of a high-pressure reservoir, lying above the working reservoir, and operating a water-ram which shall not only lift all the water out of the well back into the working reservoir, but lift the water which operates the ram back to its original height! Faith in the zeromotor must be stronger than that faith which will move mountains!

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WOOD WEAVING.

We take the following details concerning a very peculiar industry from a recent number of *Cassell's Magazine:* One of the busiest towns of the manufacturing district of the Austrian empire is Ehrenberg, lying close to the Saxon frontier, and distinguished from other towns and villages for its curious industry of wood weaving—*sparterie* work, as it is called—which was introduced something more than a century ago by a carpenter named Anton Menzee. The threads used for weaving are no thicker than writing paper, and vary in width from the fifth to the twenty-fifth part of an inch. The aspen is the only tree whose wood is sufficiently tough and pliable to supply these threads in the required lengths. This tree was formerly indigenous to Bohemia, but has now almost entirely disappeared, so that the raw material for the *sparterie* work has to be brought from Russian Poland. The wood used for the purpose of weaving must be free from knots, as the smaller defects or irregularity, such as ordinary persons would hardly notice, make the fibers quite unfit for working. Arrived in Ehrenberg, the wood is planed and divided into pieces nearly 2¼ inches wide. When these have been made perfectly smooth they are divided again by an instrument resembling a plane, but furnished with a number of fine knife blades, which mark the wood at regular distances, according to the width the strips are to be. This process requires the utmost dexterity and nicety, as it is absolutely essential that the divider shall exactly follow the direction of the fiber, and for this reason, among others, it must always be done by hand.

The divider makes incisions one-fifth of an inch deep; the wood is then carefully planed and comes off in thin paper-like strips, some of them not wider than a stout thread. They are gathered up by women as they fall, and are examined and the defective pieces rejected. There is a good deal of waste in the process. The threads or fibers being ready, must be tied in couples at one end before they can be woven. This work is done by little children of four years of age and upward, who earn eight cents a day. The weaving is done chiefly by women, and on looms which differ considerably from those in ordinary use, the fiber being not more than 39 to 50 inches in length. The longer fibers form the warp, the shorter the woof, which are passed in and out by means of a little instrument with an eye like a needle. Until within a few years this concluded the whole process—the "foundations," as they are called, were complete, and nothing more was done except that a few hats and caps were made of them. These were of the simplest description, and anything but becoming; moreover, they were glued together, thus making them unpleasant to wear in hot or wet weather; accordingly they brought but 30 cents or 60 cents per dozen, and were worn by the very lowest classes.

Within the last few years, however, owing partly to the interest taken by the Government in the manufacture, a great change for the better has taken place. At present Ehrenberg sends out not only the raw material, but ready-made goods—fashionable hats of all kinds and a variety of fancy articles skillfully concocted out of the wood fabric; ladies' hats of every description and of the latest fashion, such as no one need be ashamed to wear, are made entirely of wood and sold at astonishingly low prices. Men's hats are to be had of all shapes, from the Panama hat—not a whit inferior to that bought in Paris—to the common hats exported in large quantities to China, and the linings or foundations of which give stiffness to the fez of the Turkish soldier. The export trade embraces all Europe, from Spain to Russia, extends beyond the Caucasus to India and China, and maintains active relations with North and South America as well as Australia. The manufacturers are in direct communication with the four quarters of the world, and their goods are being introduced into Africa by French and English traders.

Influence of Magnetism on Electrical Currents.

At a recent meeting of the Physical Society, London, Mr. Hall, of Johns Hopkins University, Baltimore, exhibited his experiment in which a current of electricity flowing longitudinally along a thin foil of metal is caused to yield a transverse or lateral current by inserting the foil between the foils between the poles of a magnet. The lateral current is observed on a sensitive galvanometer, and care is taken in the first place to find points of connection with the foil which yield no current before the magnet is applied. The results were that if iron is called + the series is iron +, silver —, gold —, platinum —, tin —, and, curiously, nickel, though a magnetic metal like iron, is —; but on inquiry of Professor Chandler Roberts it proved that the nickel employed was, perhaps, impure. Cobalt ranges between iron and silver, and is + like iron.

EXPLOSION OF A ROLLING MILL BOILER IN POTTSVILLE, PENNSYLVANIA.

BY S. N. HARTWELL.

The subject of this report was a plain cylinder boiler with cast iron heads, a type much used in almost all kinds of manufactories. Hundreds of them may be seen of about the same dimensions and construction set in triplets, etc., in the steam cotton mills of Fall River and Lowell, Mass., and Providence, R. I., and they are very common in iron mills in all parts of this country. The sample now illustrated exploded on the 10th of June, 1881, and killed three men. It was somewhat shorter than most of its kind, and was the right-hand one of a pair placed over a puddling furnace, known as No. 4, in the Fisbach Rolling Mill, owned by Mr. C. M. Atkins, and located about a mile from Pottsville. This boiler was 30 inches diameter by about 26 feet long, made, in 1870, of a good quality of iron plates; 11 single-riveted rings composed the cylinder. The brand "C. H., Pottstown, Pa.," is seen on the plates, but no figures indicating their tensile strength were found. The heads were flat cast iron disks, about 1¾ inches thick, the front one having a man-hole in its center of the usual size. The rear head had no man hole. The flanges of the heads turned inward to receive the shell plates. The boiler had the usual water gauges and a 3 inch diameter lever safety valve. The pair of boilers were supplied with water through a cast iron T-pipe attached to the nozzles cast on the lower part of each front head. This exploded boiler and its mate were suspended by hook bolts and riveted staples, A, beneath cast iron arched girders placed upon the side walls at each end of the boilers. They were also united by a cross pipe or small steam drum of cast iron having a nozzle for the safety valve and the steam pipe by which they were connected to the system of nineteen pairs of similar boilers and four upright ones.

Except the uprights and one pair of "starting" boilers they were all similarly heated by waste gases from puddling and reheating furnaces. The combustion of the fuel is urged by a large fan-blower, that delivers cold air, through a suitable system of suspended iron blast pipes, B, into the several furnaces, whence the gaseous products of combustion pass through the reverberating chamber, and rising through a flue at the extremity they return through the chamber beneath the boilers, traversing once their length in contact with their lower half, to the brick lined iron stack, C, supported on columns above the stoker's pit, as shown in Figs. 1 and 4. Steam in this system of boilers is maintained at from 60 to 70 pounds, blowing off at 70, as indicated by gauges at each of the three large engines. The steam thus generated is used to drive the works through a 44" x 44" upright engine for a 22 inch beam train, making 82 revolutions per minute; a 24" x 60" horizontal engine for the puddling machinery, 55 revolutions per minute; an upright 36" x 36" engine for the rail mill, making 85 revolutions per minute; together with several smaller lifting engines and the fan-blast engine.

THE HISTORY

of this boiler is fully given by Mr. Atkins, the owner, who has been many years in the iron business, and uses a great number of boilers, and he is very particular to procure the best of C. H. No. 1 plates for them. He testifies, referring to his admirable record books, that this boiler was made for him in March, 1870, put to work on the 28th of April, 1873, used interruptedly, the months and days in each year being designated, in all a total of 76 months, something over half the time since 1870 till the 10th day of June, 1881, when, according to the evidence, it exhibited its first symptom of weakness, a leak on the bottom, and within a half hour after it was discovered it broke in two, as shown at *a* in the engraving, Fig. 1, near the beginning of the third plate from the front end, where the hot gases from the furnace below first impinge on the iron shell.

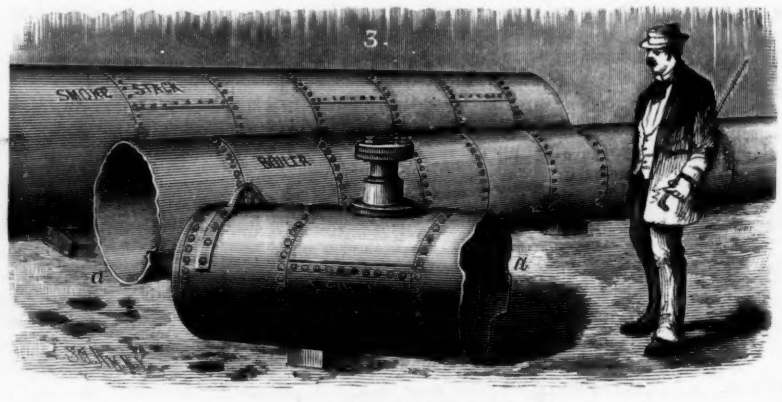
Some evidence before the coroner goes to show that the bottom of the shell was only three-sixteenths of an inch thick, and that the top was scant a quarter of an inch thick. This is probably an error, since each ring of the cylinder is composed of a single plate, as shown at *a* in Fig. 3, and it was observed by the writer to be of uniform thickness throughout. The iron measures 0·2100" just at the edge of the ruptured plate on the bottom.

THE COURSE OF THE EXPLOSION

is indicated by the illustrations; the irregular line, Figs. 1 and 3, is the location of the rupture. Here the leak on the bottom was discovered a few minutes before the boiler broke in two. The fire bars were promptly ordered out by the master mechanic, Mr. Sharpless, but the man who attempted to do it was driven from the stoker's pit beneath the stack by the steam formed of the water blown from the rapidly increasing leak into the white hot puddling chamber, whence a "heat" had just been drawn. The man left the pit (to shut off the blast which he thought had been turned on by some one), and saved himself from a horrible death in the pit, for just then the boiler broke down, and the parts separated and took directions indicated by the angle at which they were acted and reacted on by the expanding water. (See dotted lines, Fig. 1.) The shorter piece took an upward and westward course, making several back somersaults among the steam pipes, blast pipes, and timbers, and fell within 25 feet of its starting point. The main portion not having so great inclination from the horizontal, after breaking down recoiled horizontally eastward against the stack, C, which in falling to an inclined position among the timbers broke and knocked down the main blast pipe, B, and a large shaft that ran north and south across the mill.

The upper part of the furnace or boiler setting was demolished, and the boiler fell and remained upon the damaged lower portion not far from its original place, as shown in Fig. 2. A large area of roof was blown off and destroyed. Pipes and timbers in the track of the flying piece of the boiler were broken and thrown down, and steam, bricks, and splinters filled the air.

The water from the main portion of the boiler was projected by its own expansion, carrying bricks and pieces of iron with it down the "race," a thoroughfare between the furnaces, where the three fatally injured men had been at work.



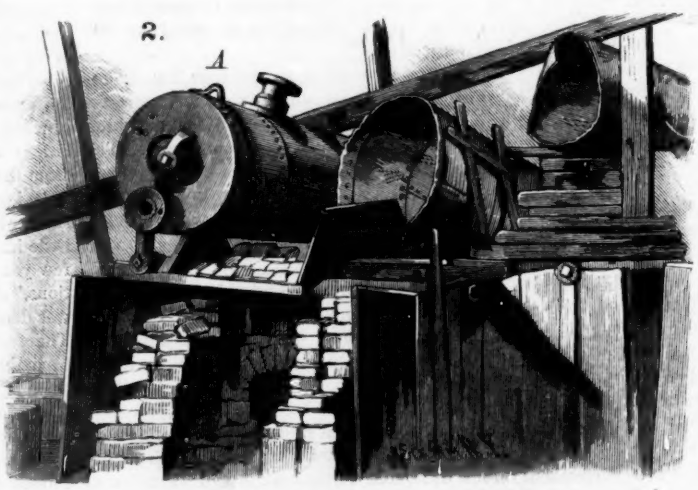
BOILER EXPLOSION, POTTSVILLE, PA.

That the weakness that distinguished this boiler among its numerous fellows was the accidental location in its construction of an obscure or entirely hidden defect in a most trying spot, is a fair hypothesis. It is said that a flexible horse-nail was forged from a piece of iron cut from the plate *near* the fracture, but it is certain that *at* the fracture the iron was crystalline and brittle. No notable defects, either original or acquired, were found in the boiler. There were marks inside, not in the line of fracture, showing that scabs of deposit had recently been detached, and slight bulging appeared, but they were unimportant, and the boiler was practically clean and appeared to have been well cared for. It had never been patched or otherwise repaired, and no blame can justly be charged to its makers, owners, or managers.

The mildness of the accident is due to the direction of the weak line and the consequent gradual character of the break. Had the boiler opened instantaneously by the bursting out of a head or the breaking of the shell on a longitudinal line, from grooving, corrosion, or a ripped longitudinal seam, and had the three tons of superheated water been suddenly set free from the pressure due to its confinement, it would have expanded something as powder burns, and a greater effect would have been produced.

So far as the writer has observed during several years of study of this subject explosions from transverse defects have been confined to boilers in iron works, all similarly set and exposed to great and sudden changes of temperature. Some of the causes are obvious, but there may be others not yet traced.

It is believed that some safer method of setting gas-heated boilers can and ought to be devised. For example, a fire-brick arch or shield might be constructed to receive the first impact of the hot gases and the succeeding colder currents of air, protect the iron from the damaging thermal changes, and distribute the heat over a larger area of the boiler.



BOILER EXPLOSION, POTTSVILLE, PA.

A jury of competent mechanics assisted the gentlemanly and zealous coroner, Dr. Will. C. J. Smith, of Pottsville, in examining this case. They rendered the following sensible

VERDICT:

"After visiting the mill at which the disaster occurred, and hearing the evidence relating to the death of Daniel Moran, Henry Lansberger, and James O'Neil, the jury find that the deceased came to their deaths from injuries received by the bursting or rupture of the boiler at Atkins' Fisbach Rolling Mill, on Friday, the 10th day of June. The jury are of the opinion that the accident resulted from the constant expansion and contraction to which all cylinder boilers are subject, destroying the fiber of the iron, reducing its normal strength to such an extent that when the fracture took place on the bottom of the boiler the metal remaining in the line of fracture was not of sufficient strength to resist the pressure to which it was exposed. These are circumstances over which neither owners nor employés have any control in this class of boilers. In our examination we found the iron to be of No. 1 character, with nearly its original thickness."

HATTERS say that the size of the human head in England and Scotland has been gradually diminishing in size within the last quarter of a century.

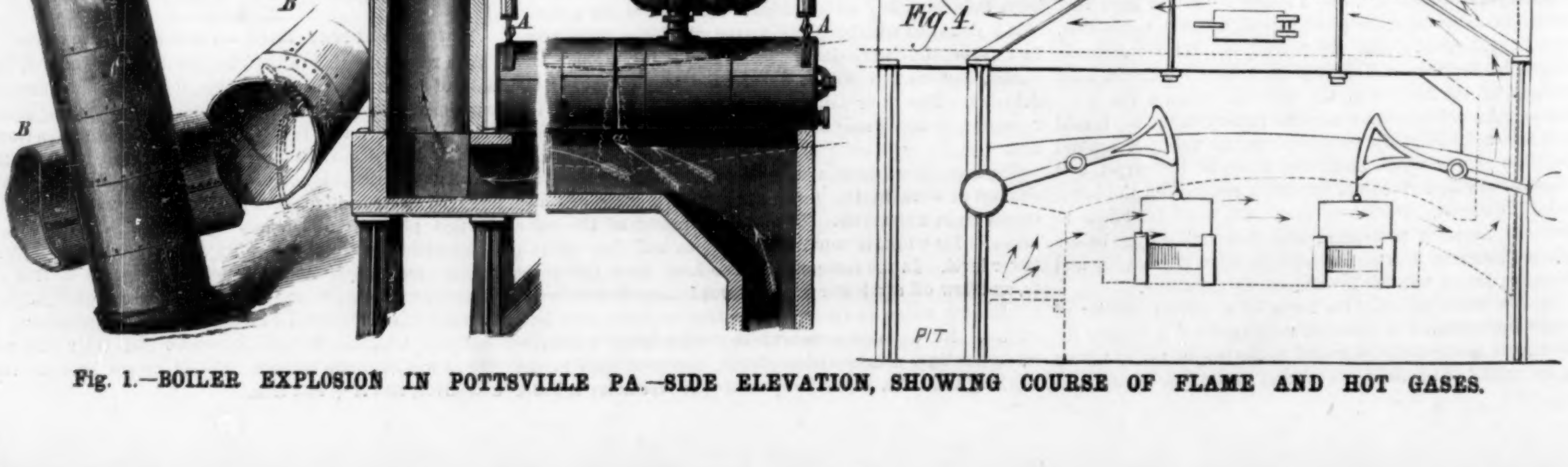


Fig. 1.—BOILER EXPLOSION IN POTTSVILLE PA.—SIDE ELEVATION, SHOWING COURSE OF FLAME AND HOT GASES.

RENEWAL OF NIAGARA SUSPENSION BRIDGE.

[Continued from first page.]

in the masonry, caused a small excavation to be made near one of the shoes. On reaching the first strand, two or three of the wires were found to be corroded quite through and others were partially corroded. Shortly afterward Col. W. H. Paine, of the East River bridge, visited the bridge, and gave orders for the removal of all the masonry covering the strands of each cable. He also made tests of the elongation of the strand portion of one of the cables, by means of a Vernier scale. He found in this way that the elongation under a given moving load, on the bridge, was no greater than the modulus of the wires would allow, supposing the total section to be the same as when the cables were new. He also cut out some pieces of wire and tested them for tensile strength, ductility, etc. Their ultimate strength was fully equal to that of the new wire per unit of section, and their reduction of ruptured section was satisfactory, but as the wires tested were etched in places, of course the stretch would be principally confined to the etched portion, hence rendering any measurement of the stretch a matter of extreme difficulty.

In March, 1877, Mr. Buck joined Col. Paine at Suspension Bridge to assist in examining the condition of the bridge and in repairing the defective wires. After the strands were thoroughly cleaned and the wire bands removed, they were opened, the paint removed from the interstices, and the inner wires examined. They were found to be in as good condition as when first put in. The outer defective wires were cut away so as to uncover the second layer of wire at the bend of the shoe, when the second layer, or course, was found to be sound and bright. Thus it was found that the only wires affected were the outer wires of the outside strands. Near the cylindrical portion of the cables, the outer wires were slightly rusted clear around the cable, but as the shoes were approached, the etching appeared to work toward the lower

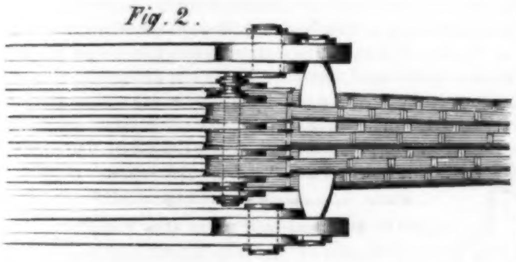


Fig. 4.—Plan showing connection of New Chains with the Cables.

strands, till, when the shoes were reached, the principal corrosion was of the outer wires underneath the bottom shoes. The evident cause of this corrosion was the elongation and contraction of the strands under the passing loads, which had loosened the cement from the outside strands, allowing moisture to work in and finally reach the lowest point. The portion of cement among the strands would go and come in a body with them.

While the examination was going on, the defective wires were cut out and new ones spliced in under strain. The greatest number of wires that required repairing at one end of any one cable was sixty-five, a number quite insignificant compared with the total number (3,640) comprising each cable.

This examination of the bridge resulted in the appointment by the bridge companies of a commission to examine the entire structure and to report upon its condition. After a very careful examination the commission reported that the repairs of wires, affected by rust, having been completed, the action of the wire portion of the cables indicated that they were in good condition. But regarding the anchor chains, it was believed that the strength of the bridge might be augmented by re-enforcing them.

The report was accompanied with plans for re-enforcement of the chains, and required that it should be made. The report also suggested the renewal of the suspended superstructure with iron, and submitted a general plan for that purpose prepared from data obtained from Mr. Roebling's published report on Niagara Suspension Bridge.

This plan was subject to such alterations as circumstances should require, and the engineer in charge accordingly made alterations which appeared to be necessary on getting to the surface of the rock.

In this plan the pits were located the same as in the other, but smaller. One anchor plate in each pit was made to answer for all the four chains. There were eight links secured in the plate by one pin, and the first joint, *c* (Fig. 3), was secured by one long pin. Beyond *c* each of the four chains was independent of the others, but had the same curvature and rested on the same stone supports. Two of the chains connected with the upper cables. The other two passed along grooves cut in each side of the wall, passing the supports of the old upper cable chains and fastened to the lower cable.

As will be seen by Fig. 3, the plan followed required a bend in the lower cable chain to bring it on to the line of the cable. This was done by dividing the change of direction among three points, and securing them in position by means of stirrups attached to the ends of the pins of the

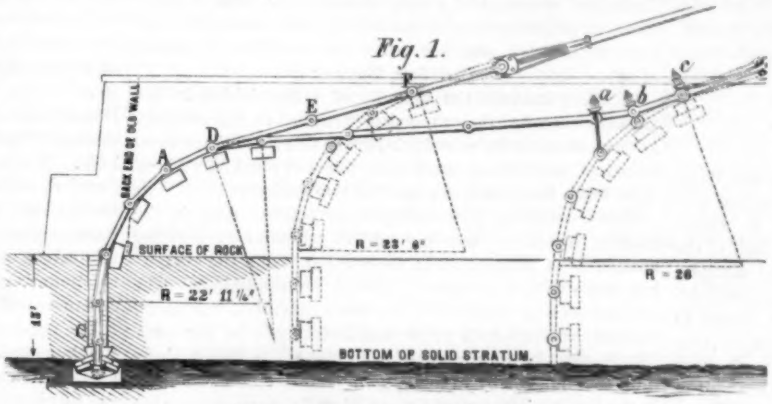


FIG. 3.—SECTION OF ANCHORAGE.

old chain, as shown at *a*, *b*, and *c*. In plan the pits are 6 ft. x 2 ft. 6 in. On the New York side they were sunk to a depth of 17 feet. On the Canada side to 23 feet. At the bottom the pits were chambered to 6 x 7 ft. in plan, for the reception of the anchor plates.

The anchor plates are of cast iron 5 ft. 6 in. square and strongly ribbed. Each plate has eight cavities cored into it for the reception of the lower heads of the links inclosing them perfectly. One pin passes through the whole eight links and all the partitions of the plate. After the plate was properly placed in the pit it was solidly concreted underneath. The stone blocks above the plate were cut to fit each place with thin joints, and the pieces as large as could be got into the chamber and notches. All vacant places were filled solidly with stone and cement, but no stone was permitted to come in contact with the chains.

After the new chains were adjusted the masonry was rebuilt and both new and old chains covered and grouted solidly, and the wire strands were covered with brick houses.

In renewing the suspended superstructure it was decided to use steel for the posts, chords, track stringers, and lateral rods, and iron for all other parts.

It was also decided to put the new iron beams in, nearly throughout, before commencing the work of erection proper. The work began at the middle and proceeded toward each end. When 150 feet of the new work was in place, the new chords were securely clamped to the old by means of oak and pine timber.

The portion of the new work thus put in place weighed about 1,100 lb. per running foot of bridge. Hence there were seldom over 90 tons of new material overlapping the old, but at the start, being in the middle, this was equivalent to about 150 tons distributed, or deducting the 80 tons, saved by stripping the bridge, there were 70 tons as the probable extra dead load upon it, but as the trains had at the outset been limited to 190 tons, it is not probable that the total weight of live and dead load ever exceeded that of ordinary usage.

While these changes were being made, the work of replacing the lower floor was going forward each way from the middle. After the work of replacing the trusses and floors was completed, that of renewing the track began at the middle and proceeded each way at the rate of 30 feet per day, or of 60 feet total. This could have been done without interrupting traffic, but as the Great Western Railway Company was to do the work of removing the old material of the track and put on the new timber, they preferred to take an hour each day, when there was no passenger train and scarcely any freight to cross, and make the change of 60 feet at one time.

The camber was made as nearly an arc of a circle as possible. The stress on the suspenders was adjusted by means of a hydraulic weighing machine.

In a suspension bridge of this sort, to make the overfloor stays (or those from the tops of the towers to different points of the floors) effective, a continuous iron truss is required, the middle point of whose length shall be as nearly stationary as possible. The trusses in this case are continuous from end to end. In order to keep the middle from moving toward either end the automatic device shown at the end of the lower chord (Fig. 5) was designed. In the prolongation of the line of the lower chord is an abutment casting, A, firmly secured to the masonry of the arch. This casting receives the end thrust of the chord. There is one of these castings at each end of each lower chord.

A bent lever, B, has its fulcrum, E, secured to A. At the end, D, of the short arm of the lever is hinged one end of a three-quarter inch diameter round rod, R. This rod extends through the lower chord to the opposite side of the river, where its other end is secured to the abutment casting

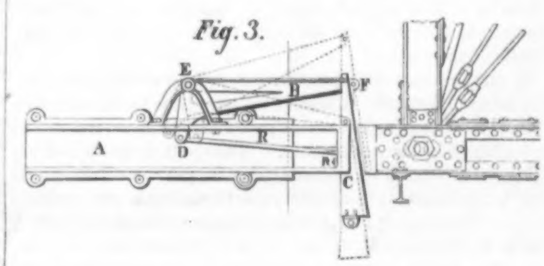


Fig. 5.—Automatic Truss Adjustment.

by a nut, *n*. At the end, F, of the long arm of B is suspended a cast iron wedge, C, which is interposed between the end of the chord and of the abutment casting. The action of the device is as follows:

The change in length of the chord, between extremes of temperature, is about 8½ inches. If the middle of the chord is stationary each end will consequently move 4¼ inches between extremes. The rod, R, which lies loosely in the chord, but otherwise is independent of it, is a little longer than the chord, and will change in length, between extremes, 8½ inches, or double the movement of either end of the chord. Hence the other end of the rod being fast, the end, D, will move 8½ inches, carrying the end of the lever with it at the same time that the end of the chord moves 4¼ inches. Arm, E F, of the lever is three times the length of D E, hence F will move 25½ inches, or six times as far as the end of the chord moves. Consequently the wedge, C, is made with an inclination 1 to 6 of its length. There is one of these wedges at each end of each lower chord. When the chord contracts the rod contracts in the same proportion and at the same time, thus bringing a thicker part of the wedge between the chord and abutment.

There is half an inch of space at each end for the chord to go and come in before bearing upon the wedge, an amount which is very nearly constant for all temperatures.

The long rods lying inside of the chord, they both keep at nearly the same temperature with each other.

The wedge has two surfaces of friction, and hence its inclination of 1 to 6 is far within the angle of friction of cast iron. Hence no matter what the pressure of the chord, it brings no stress upon rod, R, except what is required to sustain the weight of the wedge.

The weight of the old wooden structure, at its completion, was estimated by Mr. John A. Roebling at 1,000 tons. But at the date of the inspection, there having been a large amount of timber added to it, it was esti-

Fig. 2.—CARRIAGE WAY, SHOWING TRUSSES.

mated to weigh 1,130 tons. When the work of replacing the lower floor beams was in progress, Mr. Buck had one of them weighed, and found that owing to the amount of water that it held it was very much heavier than it had been estimated. He also weighed other pieces of the bridge, and from these made a new estimate, with the following result:

Total suspended weight between the towers: Old bridge, 1,228 tons; new bridge, 1,050 tons. Difference in favor of new bridge, 178 tons.

It is possible that the estimate of 1,228 tons is somewhat in excess. But as the new bridge is now higher in the middle than the old one for the same temperature, notwithstanding that the middle suspenders have been lengthened over 3 inches since its completion, that would indicate a decrease of considerably over 100 tons.

Cerebrology of Criminals.

A curious observation has been made by Dr. Moritz Benedict, of Vienna. He published a book about a year ago, "Anatomische Studien an Verbrechergehirnen," in which, among other notes, he states that in nearly one-half of the brains of persistent criminals the superior frontal convolution is not continuous, but is divided into four sub-convolutions, analogous to the disposition of the parts found in predatory, carnivorous animals. In a recent paper (*Centralblatt fur Med. Wiss.*, November 13, 1880), he argues that much of moral perversity may and must be the result of this deflection of the cerebral organs from the normal type, producing as it necessarily would, other arrangements of cerebral nutrition, and hæmostatic relations. It cannot be fortuitous that the mental characteristics of the most perverse criminals, and also the cerebral anatomy, both resemble those of wild beasts; this double analogy must be one of cause and effect.

Colored Photographic Prints.

This process consists in obtaining color photographs by means of two impressions from the negative, the first being a weak impression in order to give the outline for guiding the application of the coloring, and the second, after the colors have been applied, being an impression of sufficient strength to give the clear drawing, lights and shadows, and details of the picture.

In carrying out this process, I first take the negative in the ordinary manner. I then print on salted paper, already sensitized, a very light or faint proof of each negative, fixed and washed in the usual way. When dry I immerse the print for two or three seconds only in pure alcohol, then dry it again, and afterwards pass it through the rolling press. The print is then colored with an ordinary hair pencil in vegetable colors, the various tints being laid on smoothly, flatly, and lightly, without any regard to shading or softening off, but care being taken to have the tints brighter than they are intended to be finally. The colors are applied with the following mixture instead of with water:

Albumen of egg, 100 grammes; distilled water, 25 grammes; pure glycerine, 25 grammes; sal ammoniac, 5 grammes; liquid ammonia, 4 drops.

It will be found that the print will color more easily if it be slightly moistened and placed on a piece of glass. After the print has been colored, it is again passed through the rolling-press. When perfectly dry, the colored proof is immersed for a second time in pure alcohol, and is then albumenized in a bath composed as follows: Whites of eggs are beaten up with two grammes of very pure sal ammoniac added for every three whites of eggs, 20 per cent of distilled water, and about 4 drops of acetic acid for every 100 grammes of albumen. All is beaten up until the liquid attains a snowy appearance, when it is left at least eight days to stand. It is then decanted and ready for the colored print, which should be carefully passed over the bath and allowed to remain floating about sixty seconds. The print is then dried by heat, and finally passed through a sensitizing bath in order to be ready for the second impression. This bath is composed as follows: Distilled water, 1000 grammes; nitrate of silver, 100 grammes.

The proof is again dried, but this time not by heat, and a second impression, stronger than the first, is then taken by laying the negative very accurately over the first impression, so that all outlines, etc., rigidly correspond. This has the effect of establishing the picture, throwing out high lights, etc. The proof is then toned and fixed in the usual way, and can be afterwards enameled.

A CURIOUS fact, and one bearing on the value of submarine cables, was mentioned by Mr. Pender, January 27, in presiding at the half-yearly meeting of the Eastern Telegraph Company. It was that the company had been able, for £10,000, to pick up from a depth of 2,000 fathoms one of their cables which had been ten years in the water. The establishment of the fact that it was possible to raise a cable from such a depth of course gives an additional value to all telegraphic property.

BELGIUM promises to become the great industrial teacher of Europe. Many foreigners are now attending her schools. She has 59 technical schools, 32 industrial schools, and a higher commercial school—all receiving funds annually from the State.

Analyses of Cows' Milk.

During the winter quarter of 1880 analyses were made of the milk of forty-two cows kept at the Government Agricultural Institution, Glasnevin, County Dublin, by Charles A. Cameron, M.D., Professor of Chemistry.

The morning's milk and the evening's milk of each cow were each analyzed once; and an examination of the mixed milk of the forty-two cows was also made.

The cows, it may be mentioned, were good animals; they had from one to three crosses of the shorthorn breed. They were in the house during the period of the experiments. Their food consisted of a daily allowance of from 8 to 10 stones of pulped mangolds and turnips, and exhausted grain from the brewery, together with from one-half to 1½ stones of hay. They were, therefore, liberally fed.

In every instance the quantity of milk yielded in the morning exceeded the proportion furnished in the evening. In two instances the morning's supply was three times more abundant, and in very many cases twice as plentiful. About eight hours intervened between the two milkings.

Thirty out of the forty-two cows gave richer milk in the evening than in the morning, and eleven cows gave richer milk in the morning than in the evening, while the remaining cow's milk was equally good at both milkings. The average amount of solids in the morning's milk was 13·20, and the evening's milk 13·74—a difference of 0·54 per cent. The increase in the amount of solid matters in the evening's milk was due chiefly to the larger amount of fats contained in the latter. The amount was 4·22 or 0·4 per cent over the proportion (3·82 per cent) found in the morning's milk. In the case of the mixed milk of the forty-two cows, that yielded in the evening was richer by 0·56 per cent of solid matters, including 0·44 per cent of fats.

The results of the analyses of the milk of these forty-two cows show that the mixed milk of well-fed cows in houses, in the last quarter of the year, contains, when poorest—*i. e.*, in the morning—13·90 per cent of solid matter, including 4·20 per cent of fats. On the 2d of November the mixed milk of eight cows, which happened to be in the same house, was analyzed. One hundred parts contained: Total solid matters, 13·90 per cent; solids, *minus* fats, 9·75; fats, 4·15; ash, 0·72.

The Society of Public Analysts of Great Britain and Ireland have adopted, as a standard for the poorest pure milk, 9 per cent of solids *minus* fats, and 2·5 per cent of fats—a total of 11·5 per cent of solids. There is little doubt that milk containing less than 11·5 per cent of solids is watered or skimmed.

The mixed milk of 100 cows kept on the dairy farm of Mr. E. M. Russell, Pery Square, was found to contain at the evening's milking 13·85 per cent of solid, including 4·60 per cent of fats and 0·72 per cent of ash. The solids, *minus* fats, were 9·25 per cent. The analysis was made in March, 1881.

I think there is the strongest proof that milk on the average contains more than 13 per cent of solid matters. During the last sixteen years I have examined an immense number of specimens of this liquid, and whenever I was certain that it was pure, I invariably found it to contain more than 12 per cent of solids. I am quite satisfied that the milk of Dublin dairy herds contains from 13 to 15 per cent of solids.

METHOD OF ANALYSIS.

Ten grammes of milk were kept in a shallow capsule in the water bath at 212° Fah. until thoroughly desiccated; the residue showed the amount of total solid matters. The 10 grammes, dried and pulverized, were boiled in about 80 cubic centimeters of ether for several hours, an upright condenser being placed over the flask containing the ether to prevent a waste of the latter. The ether containing the milk fats in solution was filtered (a very small piece of filtering paper being used) into a light tared flask. The ether was distilled off, and the last traces got rid of by passing a current of hot dry air through the flask and condenser. The flask and its fatty contents were then weighed. The amount of the ash was determined by igniting at a low temperature in a platinum dish the residue obtained by evaporating 10 grammes of the milk to dryness.

It is perhaps, in part, owing to the great care taken to extract every particle of the fat that such high percentages of that ingredient were obtained.

In every instance the amount of solids was determined by two independent experiments. Many of the weighings of the fats and ash were repeated.—*The Analyst.*

Ultra Gaseous Matter in America.

On the occasion of Professor Carhart's exhibition of the Crookes experiments illustrating the ultra gaseous state of matter, before the New York Electrical Society, May 5, it was erroneously stated that the experiments had not before been publicly exhibited in this country. As shown in our issue of June 18, the same lecture, with the same experiments, had been presented to the Chicago Electrical Society, by Professor Carhart, January 24, 1881.

The Secretary of the Franklin Institute recalls to our recollection the fact that another early presentation of the subject, with illustrative experiments, was made in Philadelphia, February 17, 1881, by Mr. Alexander G. Outerbridge, Jr., of the U. S. Mint, whose lecture was published in the Journal of the Institute for April last. A still earlier exhibition of some of the Crookes tubes was made before the Franklin Institute, September 15, 1880, by Mr. Walton, of the house of Queen & Co., opticians, Philadelphia, through whom the apparatus was imported for Mr. Outerbridge's exhibition.

Cadaveric Alkaloids.

MM. Brouardel and Boutmy have communicated to the Académie des Sciences some further observations on the alkaloids developed in the animal body during decomposition—alkaloids which M. Selmi has termed *ptomaines*. According to Bouley and Lussana these substances may be developed not only after death but during life. It is still uncertain whether they are formed by simple chemical action or by the influence of minute organisms. The latter appear concurrently, but they may possibly be merely an indication that these alkaloids furnish a favorable soil for the development of this or that organism. The special object of M. Brouardel's researches was the discovery of means by which these substances may be distinguished from vegetable alkaloids. It is probable that the two have been sometimes confounded, and that this confusion has led to grave errors in medico legal investigations. It was so in a recent case in Italy, where an expert believed that he had discovered, in the body of a deceased general, evidence of delphinine; the reactions supposed to be proof of it were, however, certainly due to one of these cadaveric alkaloids.

The most effective method of distinguishing between the vegetable and the animal alkaloids is by making a complete examination of the chemical and physiological properties of the suspected substance; and if any one of these proper to a vegetable alkaloid is absent, it is probable that the substance is not this alkaloid, but a ptomaine which resembles it. This method is, however, tedious and difficult, and is only practicable when a considerable quantity of the suspected material is available. A more convenient method of distinguishing them is by the employment of ferricyanide of potassium. This substance is unaffected by the pure organic bases of the laboratory, or those extracted from the body of a person who is known to have been poisoned. The cadaveric alkaloids, however, instantly transform it into ferricyanide, and it becomes capable of forming prussian blue with salts of iron. The iodomercurate of potash gives similar reactions with both classes of substances, but the ferricyanide enables them to be distinguished. A few drops of a solution of the sulphate of the alkaloid are added to a solution of some of this salt in a watch glass, and then a drop of a neutral solution of iron determines the formation of prussian blue if the base is a ptomaine, and not if it is a vegetable alkaloid. Unfortunately there are two important exceptions to this test: morphia produces a similar effect, and so also does veratrine, but in a much less degree.—*Lancet.*

Sulphate of Ammonia from Gas Liquor.

The *Comptes Rendus* of the last meeting of the Société Technique de l'Industrie du Gaz en France contains a "Note" by M. Marché on the manufacture of sulphate of ammonia by a process which, unlike those in general use for this purpose, is applicable to small gas works. The process consists of the employment of crude sulphate of alumina, or alum cake, instead of sulphuric acid, as the reagent. This material costs about 2s. 6d. per hundredweight in the centers of production, and the authors of the process assert that in consequence of the high tariff imposed upon acids conveyed by rail, sulphuric acid would be less costly in the form of sulphate of alumina than in that of chamber or concentrated acid. The apparatus employed consists of (1) a wooden vat which is filled with liquor, to which the reagent is added in the proportion of 4·5 kilos per degree per hectolitre, and after standing from ten to 12 hours the liquor is converted into sulphate of ammonia; (2) an evaporating pan of sheet iron, in which the concentration of the liquor is effected by means of the waste heat from the ovens; (3) a small cask in which lixiviation is effected—the mother liquor returning into the pan and mingling with the liquor of other operations. The reaction is as follows:

The liquor contains sesqui-carbonate of ammonia, and in feebler proportion, hydrosulphate of ammonia. On coming in contact with the sulphate of alumina, the two salts are brought into the state of sulphate of ammonia, which remains in solution in the liquor. A precipitation of hydrate of alumina takes place, which completely purifies the liquor, while the carbonic and hydrosulphuric acids are liberated. The alumina is precipitated completely in twelve hours, and increases so rapidly in density that it may be taken out with the shovel when the cask is half empty. Therefore it is sufficient to remove, every three days, the excess of dense precipitate, which really contains but little sulphate of ammonia—not more than two per cent in fact.

The reaction is, therefore, complete. The advantages of the process are that the expense of fitting up the appliances is extremely trifling: there is not any expense for fuel, no supervision is needed, there is no wear and tear of plant, nor is any manipulation of the acid required, while the weakest liquors are utilized. The process is applicable to the smallest works, and also to those of the farthest removed from the works where the acid is produced, and with it there is the possibility of obtaining sulphate from the first distillation, owing to the purification effected by the reagent. With the same apparatus may be produced chloride of ammonium containing 30 per cent of ammonia, while the sulphate contains only from 24 to 25 per cent.

Correspondence.

An Inventors' Congress.

To the Editor of the Scientific American :

The magnitude of the interests involved in our governmental patent system demands protection and the fostering care of the nation.

It extends to the whole field of our great and rapidly expanding industries—agricultural, commercial, manufacturing, mechanical, mining, chemical and mechanical philosophy, and the broad range of the scientific developments of the world's industries.

It calls in trumpet tones upon the host of toiling inventors to rally and to concentrate their mental force for the equitable protection of their rights.

It has become, apparently, expedient to convene an *Inventors' Congress*, at Washington or New York, on or about the 15th day of November next, to take such action as may be deemed advisable, in anticipation of the meeting of the national Congress.

Among the questions for consideration by the *Inventors' Congress*, the following may be entitled to some degree of prominence :

I. The reformation and equitable establishment of our patent system.

(1) The classification of patents in conformity with a stringent rule of discriminating charges, scaled according to relative importance and periods of continuance.

(2) Adjusting and limiting the revenues to the legitimate expenditures of the Patent Office.

The present accumulation of revenue on the operations of the inventive genius of citizens is abnormal to our doctrines and system of government, and oppressive to the indigent inventor.

(3) A competitive system of premiums for indicated or prescribed inventions of national importance, and also the bestowal of moderate "*bounties*" on deserving indigent inventors.

II. The expediency of petitioning the Federal Congress to convert the Patent Office into an executive department of the national government.

The vast arena for the emulation and development of the inventive genius of our citizens would find a more expanded scope under an independent autonomy.

III. The question may be thus summarily considered as to the expediency of *inviting the nationalities of the world* to participate in an *Inventors' Congress*, at Paris, London, or Washington, to deliberate on the adoption of a plan for co operation in the administration of the great interests involved in the field of invention.

In the trite adage that "*necessity is the mother of invention,*" there is, doubtless, some truth, but it is *capital and not necessity* that profits by invention abroad, and very often at home !

The above noted interests involve a policy of national concern, inviting prompt consideration. About 243,000 inventions have authentic record, and have been already illustrated in the vast sphere of our national industries, imparting vigorous action evolved by inventive genius.

IV. The question is also presented as to the expediency of establishing a *stock exchange for patented inventions* at New York, as early as September ensuing, with branches at the great commercial centers at home and abroad, thus giving solvency to the productions of inventive genius among the world's industries.

V. It is respectfully suggested that inventors favoring these views organize in each State at the earliest practicable moment, and select delegates to an *Inventors' Congress*, to meet on the 15th day of November, 1881, on the *ratio of two at large and one for each five hundred inventors for each State represented.*

It is also suggested that the SCIENTIFIC AMERICAN—the publishers consenting—be made the organ for communication for the development of this subject.

DANIEL RUGGLES.

Fredericksburg, Va., June 25, 1881.

Comments on Letter of Mr. Daniel Ruggles.

For nearly forty years the SCIENTIFIC AMERICAN has been an earnest advocate of inventors and inventors' rights. On every proper occasion it has set forth the just claims of inventors to popular appreciation, public honor, and that pecuniary reward which is secured by the legal recognition of their property rights under letters patent. If, therefore it fails to sympathize with the movement which Mr. Ruggles proposes, its readers will understand that it is not for any lack of desire to advance in the fullest degree the lawful interests of the pioneers of material progress.

With all respect to our correspondent's judgment, we are compelled to take issue with the very first proposition he lays down, inasmuch as it implies that the interests of inventors have not hitherto enjoyed the "protection and fostering care of the nation."

The Patent Office has not always been administered as wisely as might be desired; our present legislation has been more or less defective from the first; our courts have not always been free from prejudice and error in adjudicating patent cases; nevertheless, our patent interests are and always have been under the fostering care and protection of the nation to a degree not attained or even aimed at in any other country. There is room for improvement, as there is in the administration of all human affairs; but that improvement is not likely to be furthered by denying to the nation the credit which is justly its due for its not unsuccessful efforts to encourage inventors and protect the rights of patentees.

The expediency of calling a convention of inventors, national or international, may safely be left to the decision of the vast and honorable body of men and women deserving the name. The probability of such a convention's accomplishing much, even if held, is, to say the most, very slight. Certainly Mr. Ruggles' call to reform the patent system, without a more specific indication of what is to be changed, and in what way, and for what purpose, is not likely to be responded to with any great enthusiasm, except, perhaps, by certain associations, whose interest in the "amendment" (so-called) of the patent laws has thus far boded little good to inventors.

This is not the first time that a general convention of inventors has been proposed. That such propositions have never been put into execution is not surprising when we stop to consider how narrow is the basis of common interest on which inventors and patentees can come together, calling to mind at the same time the circumstance that the troubles of inventors arise quite as often from the opposition of other inventors as from that of the public at large.

As citizens it is easy for A, B, and C to unite in all heartiness in agreeing that the public good demands the fullest encouragement of invention. As inventors representing the three tenses of the verb "to invent"—past, present, and future—it is as easy for them to find themselves in an attitude of mutual hostility. A's invention is finished, patented, introduced, and is the basis of a profitable industry. What A specially wants of the patent laws is that they should protect his monopoly, make its duration as long as possible, and not encourage overmuch the efforts of B and C to supplant him. B's invention is before the Patent Office for recognition. He has a horror of grasping monopolies. He feels it a moral duty to protect the public from the extortions of A. He would, therefore, have A's patent construed most rigorously, and the utmost latitude allowed to his own claims. If A or any other inventor has forestalled him in any particular he regards it as somehow a personal wrong, and is apt to blame the patent laws for discouraging invention or accuse the patent examiner of working in the interest of some "bloated monopolist." C is an inventor in the future tense. He wants to accomplish a certain end, and is provoked to find that A and B and possibly others have patented the very devices he wants to use. The interests which he has in common with them are apt to be overshadowed by those interests which conflict, certainly if he is at all inclined to be selfish.

In times past, when novel inventions were few, the inertia of popular habit and popular prejudice was the chief hinderance to the immediate success of new inventions. Now, improvement, progress, or whatever it may be called, is the rage; novelty is grasped at and fought over, and too often the inventor's worst opponents are those of the household of invention—his brother craftsmen.

It may be that a union of inventors would bring peace by arbitration; but we are inclined to think that such a union would have to be the product of much fighting.

The special ends which Mr. Ruggles would have the proposed convention work for do not, as a whole, impress us as altogether feasible or desirable. If the charges for letters patent were to be graded, as he proposes, according to the importance of the devices covered, there would at once arise the impossible task of deciding the relative merits of inventions. The natural tendency of inventors is to exaggerate the value of their inventions; the tendency of the officials of the Patent Office is the reverse; and it often happens that both fail to appreciate the real significance of particular inventions, the working value of which may not become fully apparent until years after the patent is granted. On the other hand, inventions which seem to be, and really are, of signal value when made, may be supplanted by better devices almost immediately, and so lapse into insignificance. Only omniscience and infinite impartiality in the Patent Office could keep the proposed discrimination from being an instrument of injustice to inventors and the source of immediate dissatisfaction to all. The suggested system of premiums and bounties to indigent inventors would be as impossible to carry out fairly, as it would be certain to open the door to corruption and scandal. Besides, the same determined effort which would secure to the deserving inventor financial assistance from a government office, would be much more likely to obtain the needed help at the hands of clear-sighted or speculative individuals. With our abundance of capital seeking opportunity for investment a promising invention need not suffer for lack of means for its development.

The proposition touching the establishment of a stock exchange for patented inventions is, in its present form, simply incomprehensible. The development of properties is in no way furthered by stock exchange operations, nor is their solvency; and we fail utterly to see how inventors could be benefited by the institution suggested—barring, of course, those of the Keely and Gamgee sort.

The propriety of adjusting the revenues of the Patent Office to its legitimate expenditures has been repeatedly urged by the SCIENTIFIC AMERICAN. On this point our agreement with Mr. Ruggles is complete.

We should be glad to see an international convention looking to a unification of the patent laws of all nations on the basis of the American system; but we see little reason to anticipate such progress on the part of foreign governments for many long years.

Rye Roots in Ice.

To the Editor of the Scientific American :

I send you a vegetable growth that I think possesses some botanical interest as an illustration of the anomalous conditions under which certain forms of vegetation can germinate and grow. These are the facts: Two years since Mr. John Gruel, a prominent confectioner of this place, called my attention to the fact that rye grains germinated and threw out long rootlets embedded in ice in his icehouse. At the time I saw a number of the grains with rootlets attached that were reported as growing in the solid ice. I did not doubt his word, but as I did not see the grains *in situ* I passed it by. Last year he did not use rye straw as a lining to his icehouse, hence there was not a recurrence of the anomaly. Last winter he again used rye straw to line his house, and last night he notified me that on removing ice he found a number of the sprouted grains. He told me I should be present to-day when he removed the ice. I was, and was witness of the following details: On removing a thick bed of ice from the wall, between which and the ice there was a packing of rye straw, I found a large number of the grains with their rootlets penetrating the solid, clear ice in various directions. The one I inclose I detached from a large lump of ice, the rootlets twining through the detached ice. The grain was contained in an ellipsoidal cavity of three-eighths inch major axis sunk in the smooth face of the ice resting against the wall. The plumule (I take it to be) ascended along a slight cavity, a prolongation of the receptacle of the grain. From the grain the rootlets spread out through the transparent ice, their track being plainly visible through the ice. Though following devious tracks, what was strange to me, the rootlets were drawn from the ice by a slight pull on the grain, as if they were not rigidly embedded in the ice.

At the same time I saw a number of similar instances, some with a greater number of rootlets and longer, but they were injured in extraction.

D. J. BENNER.

Gettysburg, Pa., June 16, 1881.

Ants as Fruit Growers' Friends.

Many of the leading orchard proprietors in Northern Italy and Southern Germany are cultivators of the common black ant, which insect they hold in high esteem as the fruit grower's best friend. They establish ant hills in their orchards, and leave the police service of their fruit trees entirely to the tiny colonists, which pass all their time in climbing up the stems of the fruit trees, cleansing their boughs and leaves of malefactors, mature as well as embryotic, and descending laden with spoils to the ground, when they comfortably consume or prudently store away their booty. They never meddle with sound fruit, but only invade such apples, pears, and plums as have already been penetrated by the canker, which they remorselessly pursue to its fastnesses within the very heart of the fruit. Nowhere are apple and pear trees so free from blight and destructive insects as in the immediate neighborhood of a large ant hill five or six years old. The favorite food of ants would appear to be the larvæ and pupæ of those creatures which spend the whole of their brief existence in devouring the tender shoots and juvenile leaves of fruit trees.—*Prairie Farmer.*

Harrison's Moon Pictures.

We have examined with great pleasure the lithographic copy in color of Mr. Henry Harrison's painting of the crescent moon, just published. It represents the moon the third day from new, with the terminator at Messier. In the earth shine on the shadowed surface several of the more prominent features of the moon are visible. The picture, 24 inches square, shows the moon 18 inches in diameter; the background is dark blue, the color of the field in the telescope an hour after sunset. The accuracy of the work is attested by our best astronomers and students of the moon, and its value to students and institutions of learning is unquestionable. The entire surface of the moon will be similarly represented in a series of six pictures, showing the moon at three days old, at five days old, at seven days old or first quarter, at last quarter, sunset at Copernicus; and the last three days of the old moon, sunset at Aristarchus. Each plate is accompanied with an outline drawing and a descriptive pamphlet. The price is $3 a plate; to be had of Henry Harrison, New York.

Fresh Water Sponges.

Mr. Potts, of the Philadelphia Academy of Natural Sciences, states that the order *Spongidæ* has many more representatives in our fresh waters than has generally been supposed. He recently described before the academy three species of *Spongilla*, which he detected in a small stream near Philadelphia. Since then he has found the *Spongilla fragilis* of Leidy plentifully in the Schuylkill below the dam, and a lacustrine form above the dam, and has obtained a very slender green species, which appears creeping along stems of *Sphagnum*, etc., in a swamp near Absecum, New Jersey, a beautiful species from the Adirondack lakes, another lacustrine form from the lake near the Catskill Mountain House, and four species from an old cellar at Lehigh Gap, Pennsylvania.

Burroughs Price Brunner.

Mr. Burroughs Price Brunner, who died in San Francisco, June 4, at the age of 52, was an engineer and inventor of some note. When but a youth he invented a linseed oil press which is still in use and substantially unimproved. Before the war he was for twelve years superintendent and engineer of the Charleston, S. C., Gas Works. Losing his property in the South he made his home in San Francisco in 1864. He constructed the gas works in King street in that city; planned and constructed the Pacific Rolling Mills —an institution which now gives employment to from 400 to 500 men—and invented a great deal of the machinery used in it, notably that employed in utilizing old steel rails. He also planned and built the Pacific Oil and Lead Works, and the construction of the Virginia City and Truckee Railroad as a steam road was largely due to his influence. At the time of his death he was superintendent of the Gas Works, Rolling Mills, and Pacific Oil and Lead Works.

IMPROVED HOISTING APPARATUS.

We give an engraving of an improved apparatus for lifting variable loads which is both safe and portable. The invention consists in a block provided with differential gearing of novel construction, provided with a safety stop device and automatic brake acting by the weight of the load.

In the engraving Fig. 1 is a side elevation of the apparatus; Fig. 2 is a central vertical section; Fig. 3 is a vertical section showing the brake mechanism, and Fig. 4 is a detail view of the chain wheel.

A is the main shaft of the mechanism, having at its ends chain wheels, *a a'*, on which are endless hand chains, *b b*. The wheel, *a*, is loose on the shaft, and has on its hub a pinion, *c*. The wheel, *a'*, which is fast on the shaft, is formed with a rim flange and internal gear. *d* is a secondary shaft carrying fast pinions, *e e'*, that mesh with pinions, *c*, and wheel, *a'*, respectively. The shafts, A *d*, are journaled in cheek plates, *f f*, which at the upper end are connected by a yoke or bar, *g*, that is fitted with a hook, *h*, for suspension of the apparatus. At the lower end, the cheek plates, *f*, are connected by a bar, *p*, on which is hung an eyepiece or ring, *i*. On the shaft, A, between the plates, *f*, a chain wheel, *k*, is keyed, on opposite sides of which there are two wheels, loose on the shaft, having their hubs extended through the plates, *f*. On the shaft, *d*, is loosely hung a bent guide piece, *t*, that laps over the chain wheel and prevents the chain from rising. The hoisting chain, *m*, passes around the wheel, *k*, and its end having the hook, *k'*, may be attached to the load, or when double power is required the chain carries the block, *n*, and has its end connected to the ring, *i*. The brake wheels, *l*, have their faces next to wheel, *k*, formed with ratchet teeth, and the wheel, *k*, is provided with four spring pawls, *o*, two on each side, consisting of straight pins set in mortises, with spiral springs behind them, so that they are projected and engage the ratchets. The rims of the wheels, *l*, are formed with V-grooves.

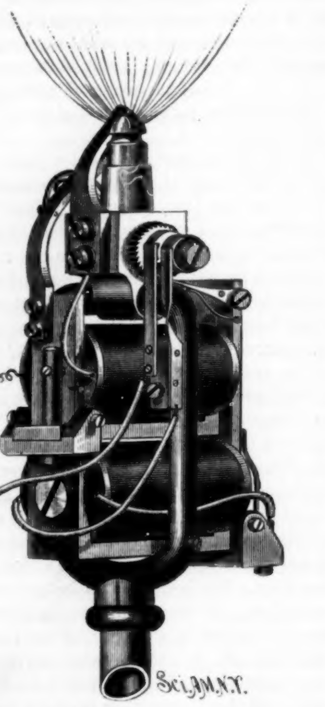
There are two curved toggle bars, *q q* (Fig. 3), hung on the lower crossbar, *p*, beneath each wheel, *l*, and extending around them at opposite sides. The upper ends of each pair of bars are connected by a right-and-left-hand screw rod, *s*, to allow of their adjustment, and the bars carry brake blocks entering the grooves of this disk, *l*. The brake blocks are in two portions—the outer portions, *r*, that are attached to bars, *q*, by bolts passing through slots, as shown in Fig. 2, and the loose V-shaped portions, *r'*, placed between the portions, *r*, and brake wheels, *l*. The adjustments of these parts may be made so that the brake blocks shall give exactly the pressure required to hold the load suspended from the shaft, A.

The load is raised or lowered by operation of either hand chain, according to the power required. The chain on the wheel, *a'*, gives the greater speed, and with heavy loads may be first used to tighten the hoisting chain and the other hand chain then used. As the chain wheel, *k*, turns in raising the load, its pawls engage the ratchets of wheels, *l*. The load on shaft, A, is sustained by brake wheels, *l*, resting on blocks, *r'*, which, in turn, are supported by bar, *p*, so that the brake is continuously applied and the chain wheels arrested by the ratchet devices the moment the hand chains are left free. In lowering the load the hand chains are to be run backward, and the chain wheel, *k*, will then give revolution to the wheels, *l*. The load will thus be at all times under the control of the operator.

It will be seen that with this apparatus four rates of speed are attainable. The apparatus is also safe and portable, and can be made of comparatively small size and used for heavy loads. The brake wheels have sufficient holding power, though made of small size, for the reason that the whole load resting on the axle is taken by the brake blocks at opposite sides of the wheels. The resistance can be varied by shifting the blocks to change the angle of resistance. This invention was recently patented by Mr. George Speidel, 933 Buttonwood street, Reading, Pa.

LIGHTING GAS BY ELECTRICITY.

Undoubtedly the quickest, safest, and cleanest method of lighting gas is by means of electricity; but before the invention of the electric lighter shown in the engraving, attempts to make a lighter which could be used to light either a single light or a large number of burners did not prove altogether satisfactory. Two electro-magnets are connected with a cock and with ratchet wheels and circuit springs, arranged in such a



RHODES' ELECTRIC APPARATUS FOR LIGHTING AND EXTINGUISHING GAS.

way that one circuit and magnet turn the cock around until it is open, and the spark is produced at the same time to light the gas. The ratchet wheel has blank spaces, so that after the gas is fully on the cock cannot be turned any farther by that electric circuit, no matter how many times the spark-producing lever is operated. The second line-wire and magnet are employed for turning off the gas, and in so doing the other ratchet wheel is brought to the position where the first pawl can act upon it, when the same is moved by the first magnet in turning on the gas and lighting it. When the gas has been turned off, the circuit to the second magnet is broken, so that the further rotation of the cock is arrested.

The upper magnet operates an armature lever carrying a pawl, which acts upon a mutilated ratchet wheel on the plug of the cock, and rotates the plug until a blank space in the wheel is reached, when the plug will not be turned further by the vibration of the armature; but each movement of the latter breaks the circuit at a point opposite the slit in the burner, and the spark of the extra current which passes at this point ignites the gas.

The vibration of the armature of the lower magnet closes the cock by a similar operation, and puts the ratchet wheel by which the cock is opened into position to be engaged by the pawl carried by the armature lever of the upper magnet. With this construction all that is necessary to be done is to gently press the button belonging to the particular burner to be lit, when the gas will be turned on and ignited instantly; by pressing another button the gas is extinguished.

The action of the device can be made entirely automatic, so that the opening of a door or window will turn on the light. Used in this way it forms an effective safeguard against the attacks of burglars.

In the sickroom or nursery, or wherever it is desirable to have a light occasionally through the night, this invention is very desirable; and it must be admitted that the device does away with great risks from fire, since no matches, tapers, or lighters are required.

For particulars, address the inventor, Mr. T. H. Rhodes, 638 Monroe street, Brooklyn, N. Y.

Behavior of Metals in Solidifying.

For some years it has been well known that water is not—as was formerly supposed—the only substance that expands in solidifying. The recent investigations of Nies and Winkelmann go to show that it is rather the rule than the exception for metals to expand in solidifying.

The fundamental experiment was putting the solid metal into the fused metal. In some cases the difference of density could be measured. They found then that tin in solidifying is increased in volume 0·7 per cent; zinc is increased 0·2 per cent; while solid bismuth is as much as 3 per cent less dense than the fused metal. The fact of expansion in solidifying was also demonstrated for antimony, iron, and copper. With lead and cadmium the results were indecisive; the former presented difficulties in the probably very small difference of density as a solid and as a liquid, its small heat conductivity and heat of fusion; the latter in the fact that in fusion it passes first into a viscous state. Thus, of the eight metals examined, six showed distinct expansion in solidifying, and the same may occur in the two others.

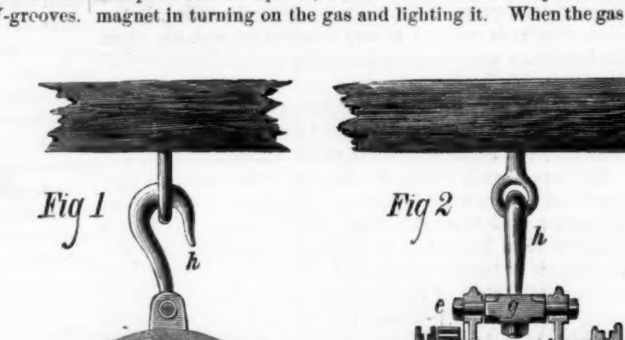
Cutting a Railroad along a Cliff.

The passengers on the Hudson River steamers have lately been entertained by the sight of gangs of workmen swarming along the face of a bold cliff jutting into the river near Cornwall, many of them suspended by ropes. A *Sun* reporter says:

The cliff was crowded with men, who, clinging like lizards to the face of the rock, were working seventy-five feet above the surface of the water; and here and there were laborers hanging (for the foothold they had obtained was hardly worthy of the name) by ropes fastened many feet above their heads, and circling their waists. All the passengers gazed with amazement at the singular spectacle; and when one of the men, turning toward the steamboat, waved his hand, cheered, and, falling off, swung for a moment, and then, getting his feet to their former place on the rock, renewed his work at cutting into its face, the spectators from the river sent back an answering cheer, as the boat swept around the point that hid the workmen from their sight, and left them discussing what they had just seen.

Greatly interested by the sight the reporter left the boat at Newburg and returned to Cornwall to inquire about the mid-air workers. He found that they were employed by the Ontario and Western Railroad Company, constructing the new North River Railroad. It is under contract to be completed by June 1, 1882, and is to run from Jersey City to Cornwall, and thence west to Middletown. The country through which it passes is so rocky and mountainous that much of the work has to be done by blasting, and this is especially the case between West Point and Cornwall. At West Point a tunnel 150 feet deep and 500 feet long has been cut through Target Hill, and many other bores, nearly as extensive, have been made. But the point already mentioned, near Cornwall, presented, perhaps, the greatest difficulties to the engineers and contractors. About eighty men are employed there, and they were selected on account of their activity and freedom from nervousness.

"They are not active enough, however," one of the surveyors said to the reporter, "to retain their foothold in every place, and at



SPEIDEL'S HOISTING APPARATUS.

certain spots it is necessary for them to work bound, as it were, to the rock, for a drop of seventy-five feet into the river below, or possibly upon some of the straggling stones that rise above the surface of the water at the base of the cliff, would undoubtedly serve to reduce our staff of workmen. Had they been sailors they might, perhaps, have managed better so far as clinging to the rock is concerned, but they could not have done the work."

The workmen are, for the most part, Italians, although a few of other nationalities are employed. Italians, however, are best adapted to the peculiar work, not only because they are lithe, light, and active, but on account of their ability to st-nd the fierce heat that beats down on the exposed face of the rock.

Population and Temperature.

A census bulletin shows the distribution of population in the United States in accordance with temperature. Arranging it in groups by 5 degrees of mean annual temperature, it is found that no less than 98 per cent of the total population live between lines marked by 40 and 70 degrees Fah. The cotton region is above 55 degrees, sugar and rice above 70 degrees, and tobacco between 50 degrees and 60 degrees. The prairie region of the Mississippi valley lies almost entirely below 55 degrees, while the great wheat region of Minnesota and Dakota is mainly below 40 degrees of mean annual temperature. The highest maximum temperature is in southwestern Arizona and southeastern California. Of the entire population, 89 per cent are found in the classes which have a maximum temperature between 95 degrees and 105 degrees. In considering minimum temperature, it is seen that 95 per cent of the inhabitants of the United States live between the lines of 35 degrees below zero and 10 degrees above, for extreme cold.

From this it is evident how population tends to increase in regions rather north of medium temperature; or, more correctly speaking, between isotherms of low degree.

PANEL DECORATIONS FOR EATON HALL.

The Duke of Westminster has recently made extensive additions to what was already an immense mansion, known as Eaton Hall. In the decorations for these new apartments great expense has been incurred to produce novel effects, and the designs for some of the rooms possess rare novelty. A small drawing room has been ornamented with twelve painted panels by Mr. H. S. Marks, R.A., who took for his models rare and curious birds from the Zoological Gardens of London. Our engraving represents a specimen of the panels produced by the artist. The *Art Magazine*, from which we take our illustration, says of the artist and his subjects:

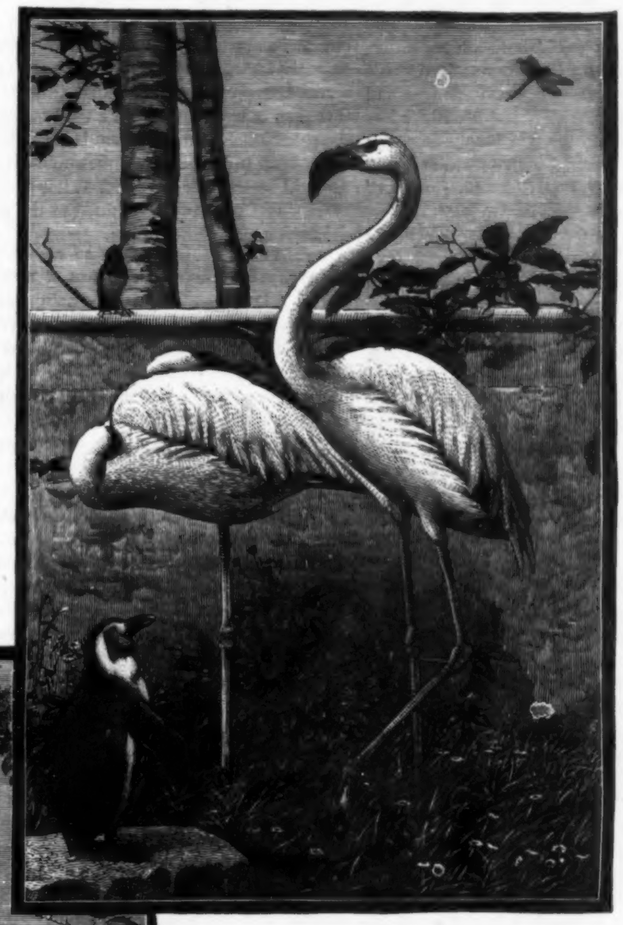
"The birds which Mr. Marks loves to give us are those which serve best to illustrate his peculiar humor. They are all funny birds with strange characteristics, fond of quaint attitudes, and given to odd ways.

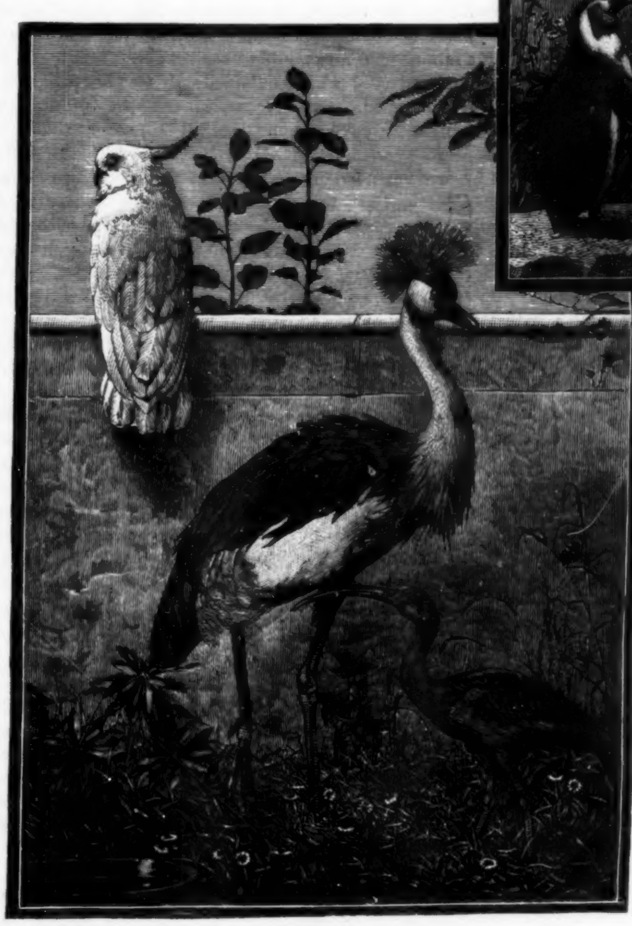
"There are no more comic birds than the crowned crane, the bird of all others Mr. Marks delights in painting. It is obvious from their manner that they possess in themselves the keenest sense of humor. Now upon one leg, the other tucked up close and out of sight, they rest quietly and solemnly brooding over affairs of state; next, they commence an absurd and ridiculous dance, threading the giddy maze in and out, and round and round, as keen and excited as any bipeds indulging in intricate quadrilles. To the dance will succeed a stately and majestic walk; after which, apparently without any rhyme or reason, they will range themselves against the fence and start off on a wild foot race.

"Compared with this extraordinary bird, the scarlet ibis, although a curious bird, has nothing very remarkable about it except its shape and color, the latter being of a glowing scarlet, which commends it to the artist for purposes of decoration. For the same reason he has selected the flamingoes which figure in the upper wood-cut. These splendid creatures, which measure from five to six feet in height, are magnificent in color, ranging from a deep scarlet to various tones of a blush pink and faint red.

"The skill of the artist has been further proved by the other birds introduced in these two panels, which have been cleverly selected, make a strong contrast, and strengthen the effect. Nothing more appropriate could well be conceived than the funny puffy little penguin looking up at the giant flamingo; or the modest robin, a bird of home affections, looking at these strange looking foreigners.

"Bird lovers, no less than lovers of art, must be grateful to Mr. Marks for these his last and most charming efforts in decoration."





PANEL DECORATIONS FOR EATON HALL.

Antiquarian Research in Mexico.

The *World's* intelligent correspondent at the City of Mexico says, in a recent letter, that the American explorer, Captain Eavans, had just returned from San Juan Teotihuacan, and had brought some Toltec relics and other antique objects, which he believes belong to an earlier civilization. These antiquities are, according to an agreement made with the Mexican Government, to be placed in the National Museum, in this city. After a thorough examination of the pyramids of "The Sun" and "The Moon," Captain Eavans commenced excavating on the site of the ancient city of Teotihuacan. The ruins of that place consist of heaps of stones and *débris* placed on some 20,000 little mounds, which formed the bases of the dwelling houses. That this city was destroyed by fire is clearly demonstrated by the heaps of charcoal and ashes found on the mounds. The walls of one building excavated and traced out were 140 by 120 feet. The stucco on the inside wall was very fine, of a bright red (which fades by exposure) and elaborate design. A piece shown your correspondent was of a beautiful crimson and white color, interspersed with mica or powdered quartz, which must have made an apartment "light up" beautifully.

You may recollect that when Mr. Charnay made excavations in Teotihuacan about a year ago he reported the finding of strata of pavement or stone work which he decided indicated three different epochs of occupation or civilization. Captain Eavans differs materially from the French explorer. He said to me: "Actual excavations and careful examination have fully convinced me that these three strata, or the 'pavements,' as Mr. Charnay called the layers, which in one place are but two feet apart, and in others only separated by six inches of earth and pebbles, are simply the foundations on which the city was built. I found beneath these layers of stone several sepulchers. Some of these tombs contained human remains interred in a manner similar to those discovered in Indian mounds in the United States. In them were also vases in which food had doubtless been deposited for the dead. There were also implements, etc., made of obsidian." Last week Captain Eavans examined the Pyramid of Cholula. He differs from others who have described it, and says: "There is no natural hillock or elevation; the entire structure is made of adobe, stone, and the *débris* of a former civilization." In conversation to-day, as on former occasions, Captain Eavans expressed a decided opinion that the Aztec civilization has been greatly over-estimated. He believes that many monuments attributed to them, for instance the "Calendar Stone," belong to the Toltecs, or even a more ancient race.

At Teotihuacan some skulls were taken from the sepulchers, and it was found that they corresponded with those discovered in the Indian mounds of the United States, not only in size, but in the peculiar flattening of the occipital region. Captain Eavans mentioned that the pottery, especially the circular dishes, in these Mexican ruins were almost identical with those found in Arkansas, and he entertains the idea that the great Toltec Empire was overrun by Indians from the north as well as by the Aztecs and by tribes from Central America. He remarked various indications that communication had existed between these races. Among other things he said: "This can be proved by implements of obsidian being discovered in the mounds of the United States, and as that substance does not exist in those northern regions the probabilities are that it came from Mexico."

A Census of the Rocks.

The Census Bureau has undertaken an interesting and valuable work in collecting information relating to quarries of building stone and the like in all parts of the country. The inquiries cover not only the location and extent of building, roofing, flagging, ornamental, and other stones and rocks, but the amount of capital employed, the annual output, methods of quarrying and dressing the stone, the number of hands employed and wages paid, methods of transportation and their cost, the number of structures of all sorts made of each sort of stone, and so on.

The aim has also been to secure duplicate samples of four inch cubes of rough rock from each quarry, for physical and chemical examination. This part of the work is being done jointly by the Census Office and the National Museum, and is in charge of Dr. Geo. W. Hawes. "One of the objects of this investigation," said Dr. Hawes to a reporter, "is to find out what minerals each one of the building and ornamental stones contains, to ascertain how each will act under different conditions as to temperature, etc., to discover the strength of each—in a word, to know all about our rock resources. Here are a half dozen different kinds and colors of granite, all unlike in structure and yet all called granite. Quarrymen and stonecutters can tell nothing about them except what you can see for yourself. Now here," said the Doctor, turning to a large block of coquina from Florida, "is a stone which answers admirably for a building stone in Florida, but if you were to build a house of it in New York it would soon tumble down. On the other hand, those granite blocks which are apparently indestructible and which are so valuable a building stone in New York, would soon deteriorate—rot, so to speak—in the Florida climate. Of course, in a scientific investigation like this we naturally solve some important economic questions and make some discoveries which will be of very great practical interest and value. For example, we know that Portland sandstone when quarried and set on edge, as it is in the walls of so many buildings in New York, will in a few years begin to scale off and give the building a ragged appearance. Again, we received some samples of rock from the only quarry in Florida—a kind of sandstone. Well, after a thorough examination and analysis of this stone we found that it contained about sixteen per cent of phosphoric acid. It is consequently a great deal more valuable as a fertilizer than it is as a building stone, but that fact had never before been discovered."

In the workshop where the stones are being polished and tested the correspondent was shown examples of the more familiar stones. A piece of Quincy granite was seen, under the microscope, to be full of pentagonal cells containing air and water. Under the action of heat the water is converted into steam and bursts the stone; hence the tendency of Quincy granite to fly to pieces in a fire.

In polishing the different faces of the sample cubes many important discoveries have been made. Sandstones and limestones, which have never been thought worthy of any better place than in the foundation or wall of some rough structure, have been smoothed and polished, and it is found

that the quarries from which they were taken contain material adapted to the most elaborate and elegant structures. Dr. Hawes declares that from the samples already received he is convinced that no country in the world is better supplied with stone for both building and ornamental purposes than is the United States; and he thinks that when all our native resources become known, as they will after the census work has been completed and its results published, the United States will cease to import stone from foreign countries.

Fish Plagues in the Gulf of Mexico.

The occurrence of areas of poisoned water in the Gulf of Mexico, causing the death of fish in vast numbers and threatening at times important industries, has been the occasion of special inquiries by the Fish Commission. As early as 1844 Mr. Benjamin Curry, of Manatee, described the effects of the plague. It appeared again in 1854, and in a milder degree on several occasions until 1878, when in several localities the marine fauna of was completely destroyed. The fatal areas are described as strips of greenish discolored water, a mile or more long, and from fifty to two hundred yards wide, strongly marked by the numbers of dead sponges and fishes floating in it. The sponges, which are usually white when the animal dies, turn black in the poisoned water; and the gills of many of the fish are covered with a froth or slime.

The latest plague followed the terrible hurricane of August, 1880, and extended from Tampa Bay to Shark River, Bahia Honda passage, and in patches by Key West, the Marquesas, and East Key, the Tortugas group.

The following account of the plague at Egmont Key is given by the agent of the Fish Commission there:

"The first dead fish we saw was on Sunday, October 17, as the tide came in. There were thousands of small fish floating on the water, most of them quite dead. I saw only one kind the first day; they were small fish, four or five inches long; the Key West smackmen called them 'trim.' They were new to me. The next day other kinds were dying all along the shore; the pompano was about the next to give in, and by the 25th of October nearly all kinds of fish that inhabit these waters were dying except the ray family. I don't remember of ever seeing any stinger or whipper ray, or the devil fish, as we call the largest ones of the ray family. From the 25th of October to the 10th of November was the worst time; during that time the stench was so bad that it was impossible to go on the beach. I sent my family to Manatee, and the assistant keeper and myself shut ourselves up in our rooms and kept burning tar, coffee, sulphur, rags, etc., night and day, in order to stand it. It was warm, damp, and calm weather. They continued to die for about six weeks; they kept getting less every day. I counted seventy sharks within eighty yards, all small; I never saw a shark over four feet long dead. The cowfish and eels were about the last to die. In regard to the cause of their dying, I have made up my mind it was caused by the fresh water, as there were immense quantities of fresh water coming down the bay, and the water here was nearly fresh on the surface, while the water underneath was perfectly salt. Now, if the fresh water could have passed off into the Gulf without being disturbed by winds it would have naturally spread out thinner and thinner as it would have rolled on toward the Gulf Stream, and once it got there then there would have been no trouble. But on the 7th of October we had a heavy gale from the southwest, and it continued to blow from the south and west until the 11th of October, and a very heavy sea running at the mouth of the bay, and it churned the fresh and salt water all up together, and the strong southerly winds set this mixed water back and kept it here for several days. I noticed a few days before the fish commenced to die a peculiar smell on the water, something like the smell of bilge water, and the color of the water was a dirty green, mixed with small sediment. I noticed the fish while they were dying, when they first came in shoal water; they would act crazy, dart around in every direction, but in a short time they would give up and float ashore. On examining them I found their gills all glued together with a slimy substance and of a whitish color, and in a short time the gills would turn green, and the fish bloat very large. I cannot make any correct statement as to the number that died, but thousands of barrels floated up on this island. There are no fish dying now; all we catch are fat and nice."

Joining Together of Glass Tubes.

In order to fuse together two pieces of glass of the same diameter they must have the ends evenly cut off. They are then both held in the flame and slowly turned, without touching each other, in order that both ends may become uniformly heated. Then they are taken out of the flame, and carefully but truly placed together. The thickening which is formed at the point of junction is removed in the following manner: The end of the tube which has been joined is either melted together or closed with a cork; then the thickening is heated in the flame, while at the same time it is very evenly rotated; after softening it is slightly blown out; then again heated, and so somewhat compressed; then blown out again. This operation is repeated until the thickening has completely disappeared. It is particularly essential that during this operation of removing and blowing out, the axes of the two tubes form a straight line. This requires some skill and dexterity of manipulation. If one wants to join a narrow tube to one which is wider, the latter is first closed at one end, and this end softened by careful rotating in the flame; then blowing into the open end, a bulb is formed at the heated end; this is broken by strong blowing. By means of a file the ragged edge is removed; often it may be cut with a pair of scissors; only a narrow rim then remains, which is rounded as much as possible by turning in the flame. In this way the end of the larger tube has been reduced to about the size of the smaller one. Both pieces are now heated at the same time in the flame, as has been previously described, due precaution being taken that the two ends were of equal diameter before they were heated together. If one of the openings is still too wide, its size is reduced by heating it a little stronger than the other, until it contracts sufficiently. The two ends being then of equal size, and having been uniformly softened, they are joined, and treated as has already been mentioned.

When it is desired to join the pieces of tubing at right angles (T-shaped), one of the tubes is closed at one end and heated by means of a small sharp pointed flame, which is blown tangentially against the tube. In this way a small, round piece of the wall of the glass tube becomes very hot, and precaution is taken that the heated portion is as much circular as possible. As soon as the glass appears to be sufficiently soft, one blows into the open end of the tube, the flame, however, being still kept directed at the heated circle; this then is blown out with a slight snap. The open end of the tube which is to be joined is now placed in the flame, and when both tubes have become sufficiently softened, they are brought together and joined, as has been described. In the same way a tube may be joined to the side of the bulb.—*M. B., in Journal of Education.*

Strawberries and Garden Truck by the Barrel.

The following method of growing strawberries in barrels is not novel, but it has been recently vouched for as a practical and profitable success. It would seem to offer many advantages for people in villages with little or no garden space. Bore fifty holes in a barrel with an inch auger, and sink the bottom of the barrel an inch or two in the ground. Fill the barrel with rich loam to the level of the first row of holes; then insert the strawberry plants, taking care that the roots are well secured. The row completed, fill up the barrel to the second row of holes, and set out another row of plants, and so on till the barrel is full. For watering and fertilizing, set into the top of the barrel an old tin can with a perforated bottom, filling the can with proper fertilizers. The barrel of plants can be kept irrigated by water enriched by passage through the can; or good results can be obtained by irrigating with soapy wash water without fertilizers. Fifty well nourished plants will furnish a family with many messes of berries, and three or four barrels covered with plants would be equal to a good sized strawberry bed. The plants should be set out in the fall, and might be covered for protection during the winter.

A modification of this plan is strongly recommended by the *Prairie Farmer*, Appletons' *Home Garden*, and other authorities, for growing melons, cucumbers, tomatoes, etc., in places where regular gardening is not practicable.

What is needed is a few barrels. Bore holes around the middle, and one hole large enough to admit the nose of your watering pot. Fill the barrels with stones as high as the rows of holes, and fill in with good, rich, fine earth to the top, in which plant cucumbers, melons, squashes, tomatoes, etc. One barrel will be enough for each kind. Be sure to have one large flat stone lean over the large hole where you will pour in water until it runs out of the holes you have made, and which will prevent the earth from filling this large hole up. Range the barrels around your yard and plant your seeds. Keep the barrels filled with water up to the holes, and you have all the requisites for rapid, healthy growth—air, heat, and moisture. You can raise all the vegetables you will need in the greatest perfection, and they will last until late in the autumn, as they can easily be covered on frosty nights. Cucumbers and tomatoes may hang over the barrels, cutting them off when they reach the bottom. Melons may be tied to the wall fence. The stones have an important service in holding up the earth, and in absorbing the heat during the day, which they give out at night, keeping the water at an even temperature. You will be astonished at the result, if you have never tried it.

Interesting Ring Trick.

Some years ago great stress was laid upon the ability of certain spiritual mediums, so-called, to pass upon the arm of another person an unbroken iron ring, the person's hands being clasped all the time by the medium's two hands. Mr. W. I. Bishop lately showed a gathering of scientific and literary people in London how it is done. He bandaged the eyes of Mr Sime, saying that it was for that gentleman the same as if the gas was turned out. He then caused Mr. Sime to place his hands together on his knees, brought his own hands from each shoulder of Mr. Sime to his hands, placed one of his hands on Sime's two, and said: "You feel now that both of my hands are touching yours." "Certainly," said Mr. Sime, "I feel both of your hands." Bishop had one hand perfectly free, and slipping it through an iron ring placed the free hand back. The ring was thus held on their joint arms, Mr. Sime having no idea that Mr. Bishop's right hand had left his for an instant. He said the illusion was perfect. So much can be done with a remarkably shrewd Scotchman in the dark while every one else is smiling at the simple process. Mr. Bishop then got Henry Labouchere to write five names and roll them up in pellets, *à la Foster*. After they had been written and placed by Mr. Labouchere in an envelope, Mr. Bishop came upon the platform and sat opposite him at a table. Mr. Labouchere was then requested to lay the pellets out on a table, and Mr. Bishop wrote out successively on a sheet of paper every name that had been folded up. Mr. Labouchere had watched every movement very keenly, but was entirely deceived. Mr. Bishop then showed that it was done by holding between his fingers a dummy pellet which he substituted for each of the five in turn, so that five should always appear on the table, while really one of the real pellets was in his hand to be read.

Influence of Minute Traces of Impurities on the Properties of Metals.

That alloys have often properties quite different from those of the component metals is a well known fact. But the remarkable effect of some impurities—they cannot be called alloys—on metals is not so familiar to most people. In a recent lecture by W. C. Roberts, before the Royal School of Mines, in London, the following interesting illustrations were given:

The presence of only one three-hundredth of one per cent of antimony in a mass of molten lead, the surface of which is exposed to the air, will cause it to be rapidly oxidized, while a similar mass of lead of equal surface, but free from the minute quantity of antimony, will be but slowly acted upon; and it has been shown that seven one-thousandths of one per cent of copper is detrimental to the lead employed in the manufacture of white lead.

The presence of one-twentieth of one per cent of lead or certain other metals in standard gold will render a bar an inch thick so brittle that it may readily be broken by a slight rap with a hammer. Less than one-half of one per cent of iron in metallic copper will reduce the electrical conductivity by about sixty per cent, while a far smaller quantity will render it quite unfit for manufacture into telegraph cables, or for other electrical purposes.

Dr. Fleitmann has recently shown that nickel, which breaks under the rolls, may be made perfectly malleable by the addition of a little over one-tenth of one per cent of magnesium. An ingot of a certain variety of steel containing no manganese will break into pieces at the first blow of the hammer, whereas a similar ingot containing eight one-hundredths of one per cent of that metal will forge readily.

Certain plates of Swedish puddled iron exhibited in the Paris Exhibition of 1878 were found to have a far higher resistance to fracture by impact than certain other plates compared with them; and yet analysis proved that the main difference between them lay in the fact that the good plates contained only two one-hundredths of one per cent of phosphorus, whereas the inferior plates contained one-tenth of one per cent more.

Carbon, it is well known, gives to iron fusibility, and renders it capable of being cast in moulds. The results of very many experiments appear to show that the presence of fifteen one-hundredths of one per cent of carbon converts iron into steel, rendering it capable of being slightly hardened; with more than one and a half per cent of carbon the metal ceases to be malleable, and it is known as cast iron.

The influence of carbon on the tensile strength of steel is very remarkable. Two samples under identically favorable conditions as to their amount of sulphur and phosphorus, but containing fifteen one-hundredths and eighteen one hundredths of one per cent of carbon, respectively, will differ by six tons per square inch in breaking strain, or by an increase in the latter case of twenty-seven per cent.

Nickel can be made malleable by the addition of three-tenths of one per cent of phosphorus. M. Nyst, of the Brussels mint, has lately found that the presence of fifteen one-hundredths of one per cent of silicon in standard gold will so affect its molecular groupings as to render it possible for a thin strip to bend by its own weight, as zinc would, in the flame of a candle.

Pin Manufacture.

The pins used in this country are made by fourteen factories, chiefly located in New England. Their annual production for several years past has been about 7,000,000 pins. This number has not varied much for some years, the demand remaining about the same. Two years ago the competition among the nine principal companies then existing for the manufacture of toilet pins led to such a cutting of prices that the business became unprofitable, and the market was flooded with goods. A year ago a combination was formed of three wire companies, and now all of the pins made by them are shipped to New York, and handled by the head agency of that city. From their common warehouse they are sent to every part of the country. The importations of English pins are small, and the exportation of pins from the United States is confined to Cuba, South America, and parts of Canada. England supplies almost the whole world outside of the United States, although the American pins are not inferior in quality. The raw material—the brass and iron wire from which all American pins are made—is from the wire mills of this country, and much of the machinery is of American invention and patent.—*North American Manufacturer.*

BEETLES AS A TEST OF WOOL.—A French entomologist asserts that the wool of different countries can be distinguished in market by the beetles which frequent the bales. He has identified 47 species in Australian wool; 52 in South African wool; 30 in South American wool; 16 in Spanish; and 6 in Russian wool.

LUBRICANTS.

In answer to a number of correspondents we publish the following:

The desirable features of a good lubricant or unguent may be briefly stated thus: It should, first of all, reduce friction to a minimum, should be perfectly neutral, and of uniform composition. It should not become gummy or otherwise altered by exposure to the air, should stand a high temperature without loss or decomposition, and a low temperature without solidifying or depositing solid matters. The question of cost and adaptability to the requirements of light or heavy bearings are also important considerations.

The finest lubricating oils in the market—those used for watch, clock, and similar delicate mechanism—are chiefly prepared from sperm oil by digesting it in trays, with clean lead shavings, for a week or more. Solid stearate of lead is formed, and remains adhering to the metal, while the oil becomes more fluid and less liable to change or thicken on chilling.

Sperm oil is used for lubricating sewing machines and other light machinery. Some of the oils sold for this purpose contain cotton seed oil and kerosene, and others are composed largely of mineral, sperm, or signal oil—a heavy, purified distillate of petroleum

Good heavy lubricating oil is made from heavy paraffine oil (a distillate of petroleum). Owing to "cracking" (decomposition of the vapors of the heavy distillate into lighter products), which takes place in the still, the crude oil contains a large per cent of light offensive oils, too thin for lubricating purposes. In Merril's process these are separated by blowing superheated steam through the oils, heated just short of its boiling point in the still, the lighter oils being driven off, a neutral, nearly odorless, heavy oil, gravity 29° B. to 26° B., and boiling at about 575° Fahr., remaining. When mixed with good lard oil it makes an excellent and cheap lubricant.

Common heavy shop and engine oils are commonly variable mixtures of heavy petroleum or paraffine oils, lard oil, whale or fish, palm, and sometimes cotton seed and resin oils. There are nearly as many of these composite oils in the market as there are dealers in such supplies. The following is one of them.

Petroleum	30 per cent.
Paraffine oil (crude)	20 "
Lard oil	20 "
Palm oil	9 "
Cotton seed oil	20 "
	99

Solid or semi solid unguents, such as mill and axle grease, etc., are prepared from a variety of substances. The following are the compositions and methods of compounding a few of these:

Frazer's axle grease is composed of partially saponified rosin oil—that is, a rosin soap and rosin oil. In its preparation, one half gallon of No. 1, and two and one-half gallons of No. 4 rosin oil, are saponified with a solution of one-half pound of sal soda dissolved in three pints of water, and ten pounds of sifted lime. After standing for six hours or more, this is drawn off from the sediment and thoroughly mixed with one gallon of No. 1, three and one-half gallons of No. 2, and four and two-third gallons of No. 3 rosin oil. This rosin oil is obtained by the destructive distillation of common rosin, the products ranging from an extremely light to a heavy fluorescent oil or colophonic tar.

Pitt's car, mill, and axle grease is prepared as follows:

Black oil or petroleum residuum	40 gallons.
Animal grease	50 pounds.
Rosin, powdered	60 pounds.
Soda lye	2¼ gallons.
Salt, dissolved in a little water	5 pounds.

All but the lye are mixed together and heated to about 250° Fahr. The lye is then gradually stirred in, and in about twenty-four hours the compound is ready for use.

Hendricks' lubricant is prepared from whale or fish oil, white lead, and petroleum. The oil and white lead are, in about equal quantities, stirred and gradually heated to between 350° Fahr. and 400° Fahr., then mixed with a sufficient quantity of the petroleum to reduce the mixture to the proper gravity.

Munger's preparation consists of:

Petroleum	1 gallon.
Tallow	4 ounces.
Palm oil	4 "
Plumbago	6 "
Soda	1 ounce.

These are mixed and heated to 180° Fahr. for an hour or more, cooled, and after twenty-four hours, well stirred together.

A somewhat similar compound is prepared by Johnson as follows:

	Liquid.	Solid.
Petroleum (30° to 37° gravity)	1 gall.	1 gall.
Crude paraffine	1 oz.	2 oz.
Wax (myrtle, Japan, and gambier)	1½ oz.	7 oz.
Bicarbonate of soda	1 oz.	1 oz
Powdered graphite	3 to 5 oz.	8 oz.

Maguire uses, for hot neck grease:

Tallow	16 pounds
Fish	60 "
Soapstone	12 "
Plumbago	9 "
Saltpeter	2 "

The fish (whole) is steamed, macerated, and the jelly pressed through fine sieves for use with the other constituents.

Chard's preparation for heavy bearings consists of:

Petroleum (gravity 25°)	12 ounces.
Caoutchouc	2 "
Sulphur	2 "
Plumbago	4 "
Beeswax	4 "
Sal soda	2 "

This composition is stirred and heated to 140° Fahr. for about half an hour.

The following are a few of the compositions for lubricating that have been patented:

Petroleum residuum, alkali, ammonia, and saltpeter.
Graphite, oil, caoutchouc.
Asbestos and grease.
Lignumvitæ and spermaceti.
Ivory dust and spermaceti.
Tin and petroleum.
Zinc and caoutchouc.
Plastic bronze and caoutchouc.
Tallow, palm oil, salts of tartar, and boiling water.
Oil, lime, graphite, castor oil.
Shorts, soapstone, and castor oil.
Petroleum residuum, salt, caustic potash, sal ammoniac, spirit of turpentine, linseed oil, and sulphur.
Petroleum residuum and flour.
Petroleum residuum, lard, sulphur, and soapstone.
Mixed heavy and light petroleum.
Oil, wax, caoutchouc, rosin, and potash.
Petroleum residuum, sal soda, sulphur, and kerosene.
Glycerine, graphite, asbestos, kaolin, manganese, soapstone, sulphide of lead, carbonate of lead, and cork.
Saponified resin, wheat flour, petroleum, animal fat, and soda.
Type metal and caoutchouc.
Anthracite coal and tallow.
Tin oxide and beeswax.
Soapstone, magnesia, lime, and oil.
Sulphur and petroleum.
Vulcanized caoutchouc, petroleum, and tallow.
Paraffine oil and milk of lime.
Asbestos and tallow.
Spermaceti and India-rubber.
Tallow, petroleum, soda, and hair.
Mercury, bismuth, and antimony.
Petroleum, sal soda, lime, tallow, lard, salt, pine tar, turpentine, camphor, and alcohol.
Sulphur, plumbago, mica, tallow, and oil.
Palm oil, paraffine, tallow, alkali, and asbestos.
Tallow, oil, paraffine, and lime water.
Flax seed oil, cotton seed oil, tallow, and lime water.
Petroleum, tallow, beeswax, soda, and glauber salt.
Animal oil, croton oil, spermaceti, tallow, soda, potash, glycerine, and ammonia.

Sheets of paper or woven fabrics impregnated with graphite, steatite, paraffine, tallow, size, and soluble gums.

Tissue Negatives from Gelatine Plates.

BY WILFRED BAILEY.

The method of removing the films from collodion plates by means of a coating of transfer collodion, and subsequently either remounting them upon the glass in a reversed position to be utilized in processes requiring "reversed negatives," or preserving them as "tissue" negatives, in which form they may be printed from either side, will probably be familiar to most readers of the *News*. I am not aware, however, that any method has been made known for the application of the process to gelatine plates, which present somewhat more difficulty, so a few particulars of the treatment which I have found successful may not be unacceptable.

The collodion is prepared from one of the usual formulæ for the purpose, as follows: Ether, 5 ounces; alcohol, 0·805, 10 ounces; castor oil, ¼ ounce; pyroxyline, ¼ ounce.

The gelatine negative (in a dry, and, of course, unvarnished condition) is flowed liberally with the collodion, leveled, and allowed to dry. The film is then cut through to the glass at a short distance from the edges, and the plate left to soak in water for some twenty-four hours, after which it will be found that the film may be lifted by a corner, and easily detached from the glass. It may then be reversed, and laid upon the glass under water in a similar manner to that adopted with carbon tissue, the superfluous water being afterward gently pressed out, care being taken not to injure the gelatine surface, which is somewhat tender at this stage. The plate should then be allowed to dry (not too quickly, or the film will have a tendency to peel off the glass). If only a reversed negative is wanted it is now ready for use; but if a tissue negative is desired, the plate should again be flowed as before with the collodion, dried, cut round, either at the edges where previously cut, or to any size and shape desired, and then soaked in water until it can be easily removed from the glass, which will be the case in a few minutes. The film may then be dried in blotting paper, and preserved between the leaves of a book (one interleaved with tissue paper will be found convenient for the purpose).

To print, the film may be laid upon a piece of glass in the printing frame, and will be found to lie flat without difficulty in a dry state; but, if desired, it may be mounted as before with the aid of water and dried. In the latter case it will be generally found necessary to soak the plate a few minutes in water when the film is to be removed from the glass. In all stages of the process where soaking in water is required, be careful to continue it long enough, as if any adhesion exists between the film and the glass, damage to the former will ensue on attempting to remove it.

I was led to employ this method chiefly for the purpose of printing my negatives by the single transfer carbon process, which I consider the best and most convenient (for an amateur especially) that exists, but I find also great advantage in the small space occupied by the tissue negatives, and their portability. The tissue is very tough, and cannot easily be torn (unless a cut or tear has begun at the edges, in which case great care is requisite). The second coating of collodion acts as a protection to the inclosed gelatine film, and adds substance to the tissue, while it prevents the "cockling-up" which the sensitiveness of the gelatine to moisture causes if it is attempted to use the film as a tissue on its first removal from the glass, without a second application of the collodion as directed. Of course the same treatment may be applied to transparent positives, and might be useful for other purposes.—*Photographic News.*

The Treatment of Sea Sickness.

The *Tribune* has been making inquiries among prominent physicians touching the cause and cure of sea sickness:

"What advice in regard to sea sickness would you give a patient going to sea?" was asked of Dr. Alonzo Clark.

"I should tell him to take a wash basin into his stateroom," responded Dr. Clark, cheerfully.

"Then there is no remedy?"

"One remedy, yes—to stay ashore." Dr. Clark continued: "I think people will be sea-sick until the millennium comes. The disorder is in a way a puzzle to doctors. It is caused by a disordered action in the brain and nervous system, and the stomach feels it as a part supplied with nerves. There is no perceptible change in the nerve tissue, but a nerve disturbance, and probably all the brain is affected. It is unaccountable that the practice of going to sea cures the disorder, although this may be owing to a circulatory accommodation. I have never made use of the various remedies suggested. Sea-sickness is modified by a low diet, and if health is much depressed the patient should keep his bed. Food should be taken as constantly as possible, and the best form is soup with toasted crackers. Any alcoholic drink will soothe some stomachs. The supposed benefit to be derived from sea-sickness amounts to very little, except, perhaps, in the case of large feeders. Of course, land sickness, caused by riding backward and in railway cars, is practically the same as sea-sickness. An instance has been lately related of a woman cured by wearing a sheet of paper over her chest, which illustrates the power of faith."

Dr. George M. Beard said: "A year ago there was no disease of which so little was known and which was so incurable as sea-sickness; now there is no disease of which so much is known and which is so perfectly curable. It is a functional disease of the central nervous system, mainly of the brain, but sometimes also of the spinal cord, and comes from purely mechanical and physical causes, being the result of a series of mild concussions. No more benefit can be derived from it than from an attack of typhoid fever. Infancy and old age are least affected by it, and it is most frequent and severe with the nervous and sensitive. In some cases there is simply congestion of the brain. The chief symptoms are headache, backache, nausea, vomiting, pain in the eyes, mental depression, neuralgic pains, sleeplessness, and nervous exhaustion. Dr. F. D. Lente, of Florida, first suggested the use of bromide of potassium as a preventive of sea-sickness in voyages between the North and South, and it was used with good results. This had also been recommended by Dr. Barker, who carefully studied the subject. My experience had led to my developing this treatment for long voyages and suggesting bromide of sodium in large doses instead of bromide of potassium. The former is less irritating to the stomach and contains more bromine than the latter, but when not procurable bromide of potassium may be used. The patient should take thirty, sixty, or ninety grain doses of bromide of sodium three times a day a few days before embarking and keep it up at sea until the danger seems to be past. The result aimed at is a mild bromization of the central nervous system, rendering it less susceptible to the disturbances caused by the movements of the ship. There is a great difference in people about the effect, and the great point is to know when to stop taking it, avoiding an excess, and not to take too little. A few people have an idiosyncrasy against bromide, but there is little or no danger from its use if patients will carefully watch for the sleepiness and indisposition for exercise which are the symptoms of mild bromization. I have known of but one failure from the proper use of bromides, and I have here several letters from persons who have crossed safely by their use, although always sick before. Of course the drug should be taken intelligently and under competent directions, as there is a great difference in different people, and every case ought to be studied separately so far as possible."

"What is sea sickness?" was asked of Dr. William A. Hammond.

"Well, I should call it a disorder of the nervous system."

"Is there any remedy?"

"I can't lay down rules for other people, but I can tell what I have found beneficial in my own case, and that is ten or fifteen drops of chloroform on lump sugar, and the use of bromide of potassium."

CHEMICAL PARADOXES.

We are accustomed to associate the idea of combustibility with paper. If it be wrapped tightly around a metallic rod it can be held in a gas flame without burning. The metal carries the heat away from it as fast as applied, becoming hot itself. After a while it will reach a temperature, provided the flame is large enough, at which the paper will burn.

This same phenomenon can be more strikingly exhibited by making a vessel of paper, filling it with water, and applying heat. No matter how hot the flame over which it is placed may be, it will not burn. The water will boil, and the heat be absorbed, or rendered latent, in the production of steam. An egg can thus be boiled in a paper saucepan—quite in the Easter vein if we were a little earlier in the season.

A sieve may be made to hold water or to float. If the interstices are very fine and the wire bright and dry, the water will not wet it, because a film of air will adhere to the wires. The lower surface of the water is divided by the meshes into a number of little spheroidal projections, in which the capillary force or internal gravitation and also cohesion come into play. These hold the water together so that some considerable power is required to force the water through the meshes. Thus we can put quite a quantity of water in a fine sieve, or place one in water and it will float. If the wires are not perfectly bright we may distribute over their surface some powder which water will not wet. The dust of bituminous coal is excellent. Carrying out this principle, needles, if bright, may be made to float without the least trouble, and will float for a long time.

Water is to be made to boil by cold. A flask half full of water is maintained at ebullition for some minutes. It is removed from the source of heat, corked, inverted, and placed in one of the rings of a retort stand. If cold water is poured on the upturned bottom of the flask the fluid will start into violent ebullition. The upper portion of the flask is filled with steam which maintains a certain pressure on the water. By cooling the upper portion of the flask some of this is condensed, and the pressure reduced. The temperature at which water boils varies with the pressure. When it is reduced water boils at a lower heat. By pouring the cold water over the flask we condense the steam so that the water is hot enough to boil at the reduced pressure. To assert that water boils by the application of cold is a chemical sophism.

It seems paradoxical to see a genuine metal melt in boiling water. It is a general rule that alloys melt at a lower temperature than any of their components. By making an alloy of cadmium, bismuth, lead, and tin, in proper proportions, we form a compound that will melt far below the boiling point of water, or about 160° F. Yet the melting point of tin, the most fusible of the four, is over 450° F. A good way to exhibit this is to make teaspoons or punch ladles of it so that they will melt in the hot fluid. It would be an illustration of the old proverb, "There is many a slip 'twixt the cup and the lip."

Double decompositions are responsible for many of our titular experiments. By mixing solutions of ferric oxide and potassic ferrocyanide we obtain Prussian blue. The solutions may be so dilute as to be colorless. So two colorless solutions produce a colored one, the suspended precipitate coloring the mixture. So may chrome yellow, or lead chromate, and mercuric iodide, and hundreds of other reactions be made to repeat this phenomenon. The acid radicals in these cases change places with each other. By proper succession very pretty effects may be produced. Thus five colorless solutions may be made to produce a colorless, a red, a colorless, a white, and a black mixture, all that is necessary being to pour from the first vessel into the next, the second into the third, and so on. Numberless other combinations can be made.

To make two colored solutions produce a colorless one we may avail ourselves of the power possessed by nitric acid of bleaching indigo. Two solutions of indigo are made; one contains a good quantity of sulphuric and hydrochloric acids, the other contains potassic or sodic nitrate. On pouring them together and warming a colorless solution results, as the sulphuric acid sets free nitric acid and chlorine, which destroys the indigo.

Two liquids are to produce a solid. This is another double decomposition. Saturated solutions of calcic chloride and potassic carbonate are poured together, when a very heavy precipitate of calcic carbonate or chalk is thrown down. At the present time this seems rather a weak affair, but in its day it was called a chemical miracle. It is for this reason that I show it to you. It is historic.

Two gases may produce a solid. This is effected by a simple combination. Ammoniacal gas and hydrochloric acid gas are both absolutely gaseous at ordinary temperature and pressure. If brought together they combine, forming a white solid substance called ammonic chloride or sal ammoniac. It is the substance used by tinsmiths to brighten the faces of their soldering bolts before tinning them.

If we immerse the bulbs of two thermometers, one in quicklime and the other in ammonic nitrate, and add water to each, contrary effects are produced. The quicklime has a strong affinity for water, and combines with it eagerly with evolution of much heat. The nitrate of ammonia, on the other hand, without much affinity for water, is very soluble, so it dissolves quickly, and in its passage from the solid to the liquid state renders latent or absorbs a great quantity of heat, causing a fall in the temperature, if rightly managed, of forty degrees. It is a very instructive experiment. To make it really impressive the water should be added from the same flask, so that there can be no fear that water of different temperatures is made to effect the result.

We now come to some phenomena of combustion. As we generally see it, it takes place in the air, which supplies the oxygen. But we can substitute for the oxygen of the air that of a highly oxidized salt such as potassic chlorate. If we mix this with sulphur, which is very combustible, and rub the two in a mortar we get a series of quite violent detonations. By the use of phosphorus instead of sulphur we have a still more violent explosive, which has to be handled with more care. The products of these reactions are primarily sulphurous and sulphuric and phosphoric oxides.

If we mix this same chlorate of potash with a proper proportion of sugar we have a mixture that the touch of a match will ignite and burn with great splendor. The carbon of the sugar unites with the oxygen of the salt. But it is quite unnecessary to use fire to start it. A drop of oil of vitriol or sulphuric acid will start the reaction, so that the deflagration will take place by decomposing the chlorate. Thus we have a solid set on fire by contact with a liquid.

We have already used phosphorus in an experiment which showed its great affinity for oxygen. By boiling it with a strong solution of potassic hydrate a mixed phosphureted hydrogen is set free which is spontaneously combustible. In practice it is made to bubble through water, and each bubble as it bursts produces a flash and spontaneous combustion. In oxygen the explosive is very violent. This gas has a special interest, as the *ignis fatuus* has been explained by it—whether truthfully or not is not certain. It is one of the most beautiful exhibitions of spontaneous combustion in all chemistry. It is susceptible of many modifications.

As a finale I propose to exhibit to you fire under water. We select as two suitable substances phosphorus and chlorate of potash. These are placed in the bottom of a flask and water poured over them. To start and maintain the combustion we add sulphuric acid. A highly oxidizing compound is formed, and the phosphorus begins oxidizing or burning with a bright light. To make it more beautiful we can add phosphide of calcium, when, in addition to the white glow of the phosphorus, we have an elegant emerald green glow added to our fire under water. It is not a safe experiment by any means, as there is danger of breaking the vessel by the violent heat caused by the reaction. S.

FIREWORK FORMULÆ.

COLORED LIGHTS.

These fires serve to illuminate, hence intensity of light with as little smoke as possible is aimed at. In the preparation of such mixtures the ingredients, which should be perfectly dry, must be reduced *separately*, by grinding in mortar or otherwise to very fine powders, and then thoroughly but carefully mixed together on sheets of paper with the hands or by means of cardboard or horn spatulas.

The mixtures are best packed in capsules or tubes about one inch in diameter and from six to twelve inches long, made of stiff writing paper. Greater regularity in burning is secured by moistening the mixtures with a little whisky and packing them firmly down in the cases by means of a wooden cylinder, then drying. To facilitate ignition a small quantity of a powder composed of mealed powder 16 parts, niter 2, sulphur and charcoal each 1, loosely twisted in thin paper, is inserted in the top. The tubes are best tied to sticks fastened in the ground.

WHITE LIGHTS.

Saltpeter	4 ounces.
Sulphur	1 ounce.
Black sulphide of antimony	1 "

YELLOW LIGHTS.

I.

Chlorate of potash	4 ounces.
Sulphide of antimony	2 "
Sulphur	2 "
Oxalate of soda	1 ounce.

II.

Saltpeter	140 ounces.
Sulphur	45 "
Oxalate of soda	30 "
Lampblack	1 ounce.

GREEN LIGHTS.

I.

Chlorate of baryta	2 ounces.
Nitrate of baryta	3 "
Sulphur	1 ounce.

II.

Chlorate of potash	20 ounces.
Nitrate of baryta	21 "
Sulphur	11 "

RED LIGHTS.

Nitrate of strontia	25 ounces.
Chlorate of potash	15 "
Sulphur	13 "
Black sulphide of antimony	4 "
Mastic	1 ounce.

PINK LIGHTS.

Chlorate of potash	12 ounces.
Saltpeter	5 "
Milk sugar	4 "
Lycopodium	1 ounce.
Oxalate of strontia	1 "

BLUE LIGHTS.

Chlorate of potash	3 ounces.
Sulphur	1 ounce.
Ammonio-sulphate of copper	1 "

For colored fires, where the mixtures are ignited in shallow pans and maintained by additions of the powders, the compositions are somewhat different.

WHITE FIRE.

Niter	16 ounces.
Mealed powder	4 "
Sulphur	8 "

YELLOW FIRE.

Niter	2 ounces.
Sulphur	4 "
Nitrate of soda	20 "
Lampblack	1 ounce.

RED FIRE.

Niter	5 ounces.
Sulphur	6 "
Nitrate of strontia	20 "
Lampblack	1 ounce.

BLUE FIRE.

Niter	8 ounces.
Sulphur	2 "
Sulphate of copper	4 "

GREEN FIRE.

Niter	24 ounces.
Sulphur	16 "
Nitrate of baryta	48 "
Lampblack	1 ounce.

BENGAL FIRE.

Sulphur	4 ounces.
Mealed powder	4 "
Antimony	2 "
Lampblack	16 "

COLORED STARS FOR ROCKETS.

	White.	Yellow.	Red.	Blue.	Green.	5 points.
Niter	16	—	—	—	—	—
Sulphur	8	1	—	—	2	7
Mealed powder	4	—	—	—	—	10
Charcoal	—	1	—	—	—	—
Nitrate of soda	—	6	—	—	—	—
Chlorate of potash	—	—	5	8	3	—
Nitrate of strontia	—	—	20	—	—	—
Gum dammar	—	—	4	4	—	—
Sulphate of copper	—	—	—	4	—	—
Nitrate of baryta	—	—	—	—	6	—

The materials are separately reduced to fine powders, mixed with the hands, moistened with whisky containing a little gum, moulded into small lumps, and dried. A small quantity of the following composition placed beneath the ball serves to throw it out of the tube:

Niter	3 ounces.
Sulphur	1 ounce.
Mealed powder	8 ounces.
Charcoal	3 "

The tubes are usually made by winding and pasting over a half inch mandrel a dozen turns or more of heavy straw paper. One end of the tube is plugged with clay or clay and plaster, and the other primed with a quick match as described under colored lights.

"Flower pots" and "fountains" are usually made in a similar manner, only the diameter and capacity of the tubes are greater. These tubes should be made of metal.

ROCKET COMPOSITION.

Niter	26 ounces.
Sulphur	5½ "
Charcoal	19 "

The head of the rocket is usually charged with a number of vari-colored stars similar to those used in Roman candles.

Lances are small paper cases, two to four inches in diameter, filled with composition, and are used to mark the outlines of figures. They are attached endwise to light wooden frames or sticks of bamboo and connected by streamers or quick match. The following are some of the compositions used in these:

	White.	Yellow.	Red.	Blue.	Green.
Niter	25	—	16	8	96
Sulphur	9	4	10	2	64
Mealed powder	5	4	7½	—	—
Nitrate of soda	—	16	—	—	—
Lampblack	—	2	-	—	8
Nitrate of strontia	—	—	30	—	—
Sulphate of copper	—	—	—	4	—
Nitrate of baryta	—	—	—	—	192

Sun cases are cases made like rocket tubes and filled with the following composition:

Niter	1 ounce.
Sulphur	1 "
Mealed powder	16 ounces.
Charcoal	4 "

They are attached to wooden frames to give long rays of sparkling light.

COMPOSITIONS FOR PIN-WHEELS, ETC.

	Common.	Brilliant.	Chinese.	White.
Niter	6	2	1	6
Sulphur	1	1	1	7
Mealed powder	16	16	7	16
Charcoal	6	—	—	—
Steel filings	—	7	—	—
Cast iron filings	—	—	7	—

Streamers or quick matches, used for communicating fire quickly from one tube to another in display pieces, are composed of the following composition packed in slender continuous paper tubes:

Niter	2 ounces.
Sulphur	1 ounce.
Mealed powder	16 ounces.
Charcoal	4 "

The mixture for golden rain is composed of:

Niter	16 ounces.
Sulphur	11 "
Mealed powder	4 "
Lampblack	3 "
Flowers of zinc	1 ounce.
Gum arabic	1 "

All the materials used in fireworks must be in the state of fine powders and perfectly dry.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

J.J.Callow's new graini'g and letteri'g catal'g,Clevel'd.O.

Barrel, Key, Hogshead, Stave Mach'y. See adv. p. 28.

A nice fitting shoe often makes a pretty foot, but it needs German Corn Remover to make it comfortable.

When your boiler front is covered with mud from the try cocks, it is a sure sign that no time should be lost in applying Hotchkiss' Mechanical Boiler Cleaner. Send for circular. 84 John St., New York.

Men, women, and children use Van Beil's "Rye and Rock" when they are sick.

Write Pulley Block Co.; Trucks and Car Pushers, Lockport, N. Y.

18 ft Steam Yacht; also 2 H. P. Engine and Boiler. Geo. F. Shedd, Waltham, Mass.

Second-hand Engines, Boilers, and Machinery. Send for price list. D. Stevenson, Jr., Harrisburg, Pa.

Blue Process or Heliography Material and Paper, at Keuffel & Esser, N. Y., Importers of Drawing Materials.

Parties owning Patents relating to Light Hardware, that wish the goods manufactured in quantity, or have patterns made for same, will find it to their interest to address Geo. Van Sands, Lock Draw 132, Middletown, Ct.

We unhesitatingly pronounce Messrs. Boomer & Boschert's press for making cider the best made. The price and terms are very reasonable, and they should be introduced in every fruit growing district. Send for illustrated catalogue to the New York office, 15 Park Row.

When you go home late, take a bottle of German Corn Remover to your wife, and it will make her happy; 25 cts.

The Patent for the Self-lighting Gas Burner illustrated in the SCIENTIFIC AMERICAN this week is for sale. Address the inventor.

4 Roll Planer and Matcher; simple and substantial; weight, 3,500 lb.; price, $500. O.L.Packard,Milwaukee, Wis.

Peck's Patent Drop Press. See adv., page 14.

Houghton's Boiler Compound contains nothing that can injure the iron, but it will remove scale and prevent its formation. Houghton & Co., 15 Hudson St., N. Y.

Manufacturers and others, send postal at once to *Manufacturers' Gazette*, Boston, Mass., for first number free. Ready first week in July.

Tarred Roof'g,Sheath'g Felts. Wiskeman,Paterson,N.J.

Long & Allstatter Co.'s Power Punch. See adv., p. 13.

Supplement Catalogue.—Persons in pursuit of information on any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Abbe Bolt Forging Machines and Palmer Power Hammers a specialty. S. C. Forsaith & Co., Manchester, N. H.

For Mill Mach'y & Mill Furnishing, see illus. adv. p.12.

List 26.—Description of 2,500 new and second-hand Machines, now ready for distribution. Send stamp for the same. S. C. Forsaith & Co., Manchester, N. H.

Combination Roll and Rubber Co., 27 Barclay St., N. Y. Wringer Rolls and Moulded Goods Specialties.

Punching Presses & Shears for Metal-workers, Power Drill Presses. $25 upward. Power & Foot Lathes. Low Prices. Peerless Punch & Shear Co.,115 S.Liberty St.,N.Y.

Improved Skinner Portable Engines. Erie, Pa.

"Rival" Steam Pumps for Hot or Cold Water; $32 and upward. The John H. McGowan Co., Cincinnati, O.

The Eureka Mower cuts a six foot swath easier than a side cut mower cuts four feet, and leaves the cut grass standing light and loose, curing in half the time. Send for circular. Eureka Mower Company, Towanda, Pa.

Saw Mill Machinery. Stearns Mfg. Co. See p. 13.

Pure Oak Leather Belting. C. W. Arny & Son, Manufacturers Philadelphia. Correspondence solicited.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Wood Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

For Machinists' Tools, see Whitcomb's adv., p. 12.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

See Bentel, Margedant & Co.'s adv., page 29.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

4 to 40 H. P. Steam Engines. See adv. p. 414.

National Steel Tube Cleaner for boiler tubes. Adjustable,durable. Chalmers-Spence Co.,10 Cortlandt St.,N.Y.

Turbine Wheels; Mill Mach'y. O.J.Bollinger,York,Pa.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr., & Bros., 531 Jefferson St., Philadelphia, Pa.

Gardiner's Pat. Belt Clamp. See illus. adv., p. 413.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

For best Duplex Injector, see Jenks' adv., p. 413.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 414.

Clark Rubber Wheels adv. See page 28.

Millstone Dressing Diamonds. Simple, effective, and durable. J. Dickinson, 64 Nassau street, New York.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

The Twin Rotary Pump. See adv., p. 413.

50,000 Sawyers wanted. Your full address for Emerson's Hand Book of Saws (free). Over 100 illustrations and pages of valuable information. How to straighten saws, etc. Emerson, Smith & Co., Beaver Falls, Pa.

Elevators, Freight and Passenger, Shafting, Pulleys and Hangers. L. S. Graves & Son, Rochester, N. Y.

Telegraph, Telephone, Elec. Light Supplies. See p. 30.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 29.

For the manufacture of metallic shells, cups, ferrules, blanks, and any and all kinds of small press and stamped work in copper, brass, zinc, iron or tin, address C. J. Godfrey & Son, Union City, Conn. The manufacture of small wares, notions, and novelties in the above line, a specialty. See advertisement on page 30.

Gear Wheels for Models (list free); Experimental Work, etc. D. Gilbert & Son, 212 Chester St., Phila., Pa.

Gould & Eberhardt's Machinists' Tools. See adv., p. 30.

Linen Hose, Rubber Hose, Cotton Belting, Rubber Belting, Leather Belting. Greene, Tweed & Co., 118 Chambers St., N. Y.

Safety Boilers. See Harrison Boiler Works adv., p. 29.

The Medart Pat. Wrought Rim Pulley. See adv., p. 28.

For Heavy Punches, etc., see illustrated advertisement of Hilles & Jones, on page 30.

Comb'd Punch & Shears; Universal Lathe Chucks. Lambertville Iron Works, Lambertville, N. J. See ad. p. 28.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 29.

Hand and Power Bolt Cutters, Screw Plates, Taps in great variety. The Pratt & Whitney Co., Hartford, Ct.

Rollstone Mac. Co.'s Wood Working Mach'y ad. p. 28.

For best low price Planer and Matcher, and latest improved Sash, Door, and Blind Machinery, Send for catalogue to Rowley & Hermance, Williamsport, Pa.

The only economical and practical Gas Engine in the market is the new "Otto" Silent, built by Schleicher, Schumm & Co., Philadelphia, Pa. Send for circular.

Ore Breaker, Crusher, and Pulverizer. Smaller sizes run by horse power. See p. 30. Totten & Co., Pittsburg.

For Sequeira Water Meter, see adv. on page 30.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) M. T. asks (1) how liquid gold is made such as is now sold in the picture frame stores. It is put up in small bottles at a high price. It is evidently gold powder in naphtha with some light varnish, enough to hold it. Would like to make it for large use. A. Send a sample of the "liquid gold" referred to. 2. Sulphuric acid has been recommended for bleaching bristles. Would like to know the process—with the usual process of sulphur fumes or without it? A. Sulphuric acid is boiled together with half its weight of sulphur in large stoneware retorts, and the sulphurous anhydride given off is passed into cold water which absorbs it. When nearly saturated with the gas this liquid sulphurous acid is used for bleaching.

(2) J. W. C. asks: What process will I have to use in order to keep the curl in false hair from being affected by perspiration or weather? A. Flaxseed water is commonly used.

(3) W. T. asks: What is the best solution for making cotton duck for awnings mildew-proof? A. Saturate the cloth in a hot solution of soap (a quarter of a pound to the gallon of water); wring out and digest it for twelve hours or more in a solution of half a pound alum to the gallon of water.

(4) P. & E. ask how to convert rancid butter into a sweet pure article fit for table use. A. 100 lb. of the butter is mixed with about 30 gallons of hot water containing ½ lb. of bicarbonate of soda and 15 lb. of fine granular animal charcoal, free from dust, and the mixture is churned together for half an hour or so. The butter is then separated; after standing, warmed and strained through a linen cloth, then resalted, colored, and worked up with about half its weight of fresh butter.

(5) W. J. asks: What is the best and cheapest way to make liquid laundry bluing? 1. A. Dissolve indigo sulphate paste in cold water and filter. 2. Dissolve good cotton blue (aniline blue 6 B) in cold water. 3. Dissolve fine Prussian or Berlin blue with one-eighth part of oxalic acid in water; or use ferrocyanide of potassium (one-twelfth part) in place of oxalic acid.

(6) B. W. G. asks: What is the best gum composition for emery wheels? Are there any works that treat on the manufacture of emery wheels? A. Vulcanized caoutchouc is one of the best binding materials; glue, shellac, vitrified borax, water-glass, and zinc oxide, litharge and glycerine, and vulcanized mixtures of gutta percha, bitumen, and oil, etc., have also been employed with some success. We know of no book giving much information on the subject. Consult "Knight's American Mechanical Dictionary."

(7) C. S. W. S. writes: Wrinkles have formed over the whole surface of my diploma (parchment). How can I remove without injury to that which is written and printed thereon? A. Place the paper face downward upon a clean piece of blotting paper. Beat up to a clear froth, with a few drops of clove oil, the whites of several fresh eggs, and with the fingers spread this over the back of the sheet and rub it in until the parchment becomes uniformly soft and yielding. Then spread it out as smoothly as possible, cover it with a piece of oiled silk; put on it a piece of smooth board, and set it aside in a cool place, with a weight on the board, for twenty-four hours. Then remove the board and silk, cover with a piece of clean fine linen cloth, and press with a hot smoothing iron (not too hot) until all signs of wrinkles have disappeared. The heat renders the albumen insoluble and not liable to change.

(8) R. H. S. asks how to bronze iron castings (by dipping). A. Clean the castings by pickling them in sulphuric acid diluted with about 10 parts of water, and scouring with sand; then dip them momentarily into a solution of 3 oz. of sulphate of copper and 5 oz. sulphuric acid in a gallon of water. Rinse in cold water immediately after dipping, and dry in sawdust. See copper plating and brass plating, pp. 33 and 3, vol. xliv.

(9) C. E. asks if there is any other way to melt glue than by first soaking it in water? A. Glue can be dissolved in acetic and in dilute nitric acids, but these solutions are not applicable for ordinary gluing. Glue can be dissolved directly in hot water, but it requires some time to obtain a solution free from lumps, so that it is preferable to soften the glue first in cold water. 2. Is there a way to bleach glue, that is, to make dark glue of a lighter shade? A. Glue may be bleached to a considerable extent by means of sulphite of soda or sulphurous acid and alum. If the color is due to carbonaceous matter, as is sometimes the case, it cannot be bleached.

(10) J. M. D. writes: I have some old zinc from Smee cells, which I would like to melt and cast into zincs for gravity cells. Can you tell me of some simple method of melting so as to save the mercury with which they are covered? A. The only practical way is to distill off the mercury by heating the zinc scrap in a retort. An iron retort is usually employed, but the following simple substitute can be made to answer: Select a large clay flower pot and tray (of the same material) free from cracks or holes. Rub uniformly over the inside bicarbonate of soda (baking soda) made into a thick paste with a little molasses, then put it into the oven and let it get thoroughly hot. Fill the pot with the zinc, broken into small pieces, invert the tray over it, as a cover, and then turn the pot bottom upward and fill in between the rim of the pot and tray with a stiff luting of clay moistened with a strong solution of sal soda. A short bent iron tube is then luted into the hole in the bottom (top) of the pot, and when the luting has dried the pot is gradually heated by immersing it in hot charcoal or otherwise, the open end of the delivery pipe dipping just below the surface of a dish of water, at the bottom of which the distilled mercury collects. The mercury all distills over below a red heat; any portion of it that lodges in the delivery pipe can be washed down after the pipe has cooled.

(11) H. S. asks for a recipe for a deep navy blue dye. A. See wool dyeing, in SUPPLEMENTS, Nos. 55, 74, 75, 76.

(12) W. E. asks for the best method of extracting tan from hemlock so as to get the essence for exportation. A. The crushed bark is put into upright copper cylinders called extractors, with removable brass bottoms, and submitted to the action of boiling water and steam. The liquid is then drawn off and passed into the next cylinder in the series, and so on to the last; there are usually three or more working "in battery." The partly exhausted bark is then treated once or twice again with fresh hot water, and is finally dropped out by opening the bottom of the extractor and fresh bark put in its place. The liquid is concentrated by boiling it down in a copper vacuum pan or in a series of vacuum pans.

(13) W. D. H. asks: With what preparation can drawing paper be covered, without discoloration, so that I can paint on some portions of the sheet with oil colors without having the oil spread or sink? A. Dissolve a quarter of an ounce of fine, clear gelatine in 6 oz. hot water, strain, and apply to the paper, and let it get dry before painting.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

M. M.—The quartzose rock contains much sulphide and carbonate of copper and is quite rich in silver. An assay would be requisite to determine its value.—M. W. C.—It is coal.—W. C. R.—Quartz crystals—no value.—W. A. M.—It is an ore of copper—a mixture of copper sulphide and carbonate, with some iron and probably a little silver. A fire assay would be requisite to determine the presence or absence of the latter.—S. L.—It is galena—sulphide of lead—the principal ore of lead.—W. S.—A silicious clay containing a large quantity of iron oxide (which imparts the color) and probably a little mercury—worth an assay. Such ferruginous clays, when properly ground, bolted, and (lightly) calcined, make good cheap paints.—S. H. H.—An analysis would be necessary to determine the value of your ore. It appears to be of good quality and worth working.—R. C.—Chiefly clay and carbonate of lime, with a little lead carbonate and quartz—sand.—J. S. D.—An argentiferous galena containing a little antimony.—J. R.—The phosphorescent powder does not compare favorably with that of the French manufacturers. It contains a slight excess of sulphur and moisture. Try drying it thoroughly and mixing it, while hot, with a small quantity of anhydrous lime soap. See late numbers of the SCIENTIFIC AMERICAN for formulæ and notes on this subject.—J. G. B.—An alloy consisting chiefly of antimony with a small percentage of lead. Not native.—B. G. N.—1. Argillaceous lime rock veined with quartz; 2. Ferruginous quartz rock; 3. Conglomerate; 4. Flint; 5, 6, 7, 9, 10, and 12, quartz pebbles; 8 and 11, rose quartz pebbles.—A. F. C.—A fine silicious clay—it might be useful to porcelain manufacturers.—J. M. P.—The clay is very impure, contains a large per cent of silica, and is not valuable for porcelain making.—S. E. M.—The batting is sized with an aqueous solution (hot) of British gum and soap appropriately colored with a little logwood and chrome.

COMMUNICATION RECEIVED.

On the quantity of solar heat. By C. F.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

June 14, 1881,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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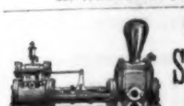

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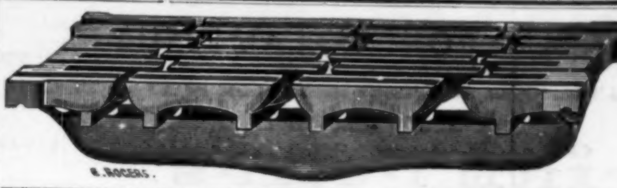

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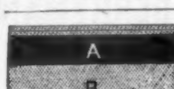

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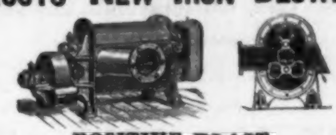

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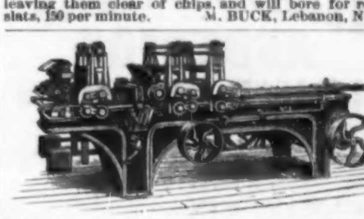

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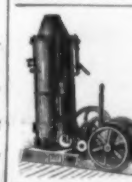

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